Abstract

This thesis is based on an action research project from Cuba where we have participated in the development of health information systems. The project was a Cuban-Norwegian collaboration project involving the Cuban Ministry of Public Health and a Norwegian research team, and was part of the larger Health Information Systems Program (HISP) network. HISP is a global research and development network that aims at improving health information systems (HISs) in developing countries. HISP started in South Africa after the fall of apartheid, and has since been extended to many other developing countries. A district health information system developed in South Africa was the point of departure for our research in Cuba, where we have aimed at adapting software and processes from South Africa to the Cuban context.

Following an action research approach, the two authors have actively participated in the systems development process at all levels of the Cuban health system and explored the Cuban context for systems development. Four databases have been developed at different levels in the health hierarchy in a prototyping approach. The efforts to adapt HISP approaches from South Africa to the Cuban context have been challenging due to very different political and organisational environments.

The two authors have actively participated in the systems development process at all levels of the Cuban health system, and following an action research method, explored the Cuban context for systems development. The adaptation of South African and HISP approaches to systems development and health information systems has been challenging in a Cuban context where political issues have played a major role.

Based on our findings from Cuba and comparisons with other countries in the HISP network, we discuss and explore appropriate approaches to systems development in Cuba specifically, and in developing countries more generally.

We argue that systems development in developing countries must take into account what is already there; the existing systems and infrastructures. Cultivation is proposed as an approach to facilitate a piecemeal adaptation process that focuses on building upon and shaping the present information infrastructure, the installed base. Through learning and cooperation such a sensitive cultivation process may enable development of a more sustainable system.

Many systems development projects in developing countries are understood as technology transfers due to the export of modern technologies and consultants from developed countries. We discuss the term technology transfer and its critiques, and apply our South African-Cuban transfer project to better understand the concept. We support the critiques, and agree that technology transfer better can be understood as processes of translation and learning.

Acknowledgements

University of Oslo

We first of all want to thank Jørn Braa for all guidance in both writing this thesis and carrying out the practical part of the research in Cuba, and also Sundeep Sahay for valuable comments on our work. We would like to thank everyone else in the HISP-team, especially Pål de Vibe for all input and productive discussions. Furthermore, we would like to talk fellow students at Parken for support and friendship.

Warm thanks go to everyone in Cuba who has made this study possible and fruitful, a list too long to mention. However, we have to give special thanks to Eduardo Zacca at the DNE who initiate the project. It has been great experience for us to work in Cuba, and we feel a special relation to the country and its people.

Johan Sæbø & Ola Hodne Titlestad

I additionally want to thank Amund, Espen, Kristian, Jørgen, Melissa, Mom and Dad for proofreading, and Ola for working with me and being a source of inspiration and understanding through one and a half year.

Johan Sæbø

I would like to thank Lars R and Lars C for valuable and enthusiastic proof reading. Furthermore, I thank Johan for good cooperation and friendship throughout an interesting and memorable time on the road in Cuba, and during the writing of this thesis. Finally, I must say that without the patience and understanding of my wife Ingvild, I never could have done all this work. More than anything, I look forward to spend much more time with you than I have been able to during my field studies in Cuba, and during the apparently everlasting writing process here at Parken.

Ola

Table of Contents

List of Figures

List of Tables

1 Introduction

This thesis is based on a Cuban-Norwegian collaborative action research project to develop health information systems in Cuba. The two authors have been part of a Norwegian research team and have worked in the project during two fieldtrips to Cuba in May-July and September-December 2002.

The following sections will be presented:

1.1 - The action research project
1.2 - Motivation –addressing the digital divide
1.3 - Research objectives and approaches to address them
1.4 - Chapter presentations

1.1 The action research project

We have actively been involved in a Cuban-Norwegian collaboration, The Cuban HISP project, which was initiated in May 2002 and finalised in July 2003. The project has been a part of the Health Information Systems Programme (HISP), a global research and development network that aims at improving health information systems in developing countries. The main objective of the project was to develop a computerised health information system in collaboration with the Cuban health statistics department. The chosen development approach and tools were based on the HISP development project in South Africa, and also influenced by development experiences from similar HISP projects in other countries.

HISP was initiated in South Africa after the fall of Apartheid in 1994. Since then HISP has taken part in the process to reconstruct the health services in South Africa and has developed a district-based health information system including software, standardisation of health data and general approaches which is now implemented all over the country. The free and open source District Health Information Software (DHIS) application, a flexible database tool, was developed in South Africa in 1997 and is still being further developed on an ongoing basis. The South African development has focused on action research, user participation and local involvement in the development of an information system aiming at strengthening local management and decentralisation in the health sector. Empowerment of local health managers through the use of local information for local decision-making is amongst the key objectives in South Africa and HISP.

The relative success of the health information system in South Africa has led to an "export" of the DHIS software and the ideas on health management to countries like Mozambique, India, Malawi, Mongolia and now Cuba. However, as will be documented in this thesis, political problems have made development more difficult in Cuba than in the other countries. The participation of Norwegian IS researchers in this international programme has been strong, and the development processes within HISP are influenced by the "Scandinavian approaches" to systems development emphasising local empowerment and user participation.

In this thesis we will describe the Cuban HISP project and discuss important aspects of transferring a South African model for HIS to a Cuban context.

1.2 Motivation –addressing the digital divide

We learned about HISP in the Information Systems group at the Department of Informatics, University of Oslo. Since we are both interested in the research field *Information and Communication Technologies and developing countries*, HISP presented a great opportunity to do research within this context. From an ideological stance we are both motivated to work for ICTs to be beneficial also for poor countries and communities, and thus to work towards bridging the "digital divide" (Castells 2001, UNDP 2003a) in an increasingly computerised global network society.

Our second motivation was to work in Cuba, a very special country which was radically transformed after the Cuban revolution. One of the last communist countries in the world, it stands alone on the western hemisphere in denouncing the capitalist driven free trade movement. While its economy lies in ruins, the health system, educational system and aid to even poorer countries are world famous.

By studying the impediments to development and use of Information and Communication Technologies in developing countries, and by discussing appropriate approaches to overcome such constraints in developing countries, we aim at contributing to this research area.

ICT and Developing Countries

The new technologies have transformed the way we communicate, travel and trade, and change our society rapidly. Castells (1996 and 2001) put forth some ideas about contemporary technological and economical development:

- The contemporary society may be termed the *network society*
- The current processes of *globalisation* cause parallel processes of *marginalisation* of those countries, regions and communities that are not part of the network society
- *Counter networks* that are working against the free market driven globalization are being established based on the same communication and Internet resources as the economic flows themselves.

First, since the major organisational and technological structures of today are the networks, Castells argues that we live in a *network society*. He uses the metaphor network to reflect a set of interconnected nodes, with no centre but which is defined by flows of information (Mosse and Sahay 2003).

Second, the driving forces of *globalisation* also lead to *marginalisation.* Globalization and marginalization are two sides of the same coin, those not benefiting of globalisation are increasingly being marginalised as they will be excluded from the economical

networks. Globalization at the pace we experience it now is not possible without ICT, and the new technology also strengthen and widen the gap between globalised and marginalised. The internet allows us to some extent to free ourselves from the old constraints of time and space, and the more people participating in global communication, the more marginalised are the ones left behind. History and society has shaped the world so that resources, knowledge, capital, and opportunities are not equally distributed around the world. Those with inability to access ICTs, runs the chance of being systematically excluded in the future.

Third, Castells talks about *counter networks*, networks of people, organisations etc, working against or contrary to the capitalist driven globalization. Such networks can be global, like Attac or Médecins Sans Frontièrs, regional, national, or local. Counter networks often use the same methods and technology as international economical networks. The HISP project may be seen as such a counter network (Braa, Monteiro, and Sahay 2003).

Heeks (1999b) says globalization demands such huge flows of information and processing of information that it could not take place without ICTs, and he suggests that the role of ICT will be mainly as a communication technology, rather than as an information processing or production technology. Without communicating in the global networks, the poor will be marginalised, but an important point is that the poor also need access to local information for action, not just information from an alien context.

What can technology do to help development?

ICT has potential usage in almost all fields, and the opportunities for development are vast. Both international and local use of IT can help development. It can be used directly to improve efficiency and production, or as means of communication, enabling producers to get access to information and compete on international markets. For instance, farming techniques, weather forecasts and prices can be obtained fast and reliably. Delivery of education and healthcare can be improved, and governments can become more efficient and transparent. Some countries have used ICT to spark new exports and attracting foreign investment by providing educated ICT-personnel and good technological infrastructure. Developing agencies and organisations stress that ICT should be considered as a *tool* for development and not as a solution in itself (OECD 2003, NORAD 2003).

What is the situation of ICT in developing countries today?

The ICT situation in developing countries today is not so bright. It is widely acknowledged that there is a digital divide between developed and developing countries (Castells 1998, 2001, UNDP 2003a). The Digital Divide has been defined by Castells as “inequality in access to the internet” (Castells 2001). Contemporary globalisation is increasing this divide (Giddens 1999, Castells 1998, Mosse and Sahay 2001, UNDP 2003a) According to the Human Development Report (HDR) 2003, only 2.5% of people living in developing countries had access to internet, in Africa and South Asia the figure was around 1%, compared to the 43% of those living in high income OECD countries. But there are also other aspects to the divide, ranging from telephones and computers to bandwidth. Johannesburg in South Africa has more bandwidth than the rest of Africa combined. Poor infrastructures, illiteracy, especially computer illiteracy,

are among other causes of less computer use in developing countries. High international prices on hardware and software limit the use by low income families. Few web pages and programs come in local languages, excluding many of those not familiar with English.

What is done with ICT in developing countries?

Many local and international projects aim to develop ICT penetration in developing countries, and to use ICT to improve various conditions for the poor. The importance of this is manifested by the UNDP (2003a):

"Information and Communications Technology (ICT) is an increasingly powerful tool for participating in global markets; promoting political accountability; improving the delivery of basic services; and enhancing local development opportunities. But without innovative ICT policies, many people in developing countries - especially the poor - will be left behind. UNDP helps countries draw on expertise and best practices from around the world to develop strategies that expand access to ICT and harness it for development." (ibid.)

Implementing use of ICTs in developing countries has proven problematic, and a majority of projects fail to a greater or lesser degree (Heeks 2002, Mursu et al 1999, Korpela et al 2000). Problems related to IS projects in developing countries are:

- Problems with laws and organisational politics
- Conflicts
- Low educational level
- Technical infrastructure

A survey of African projects by the World Bank found that the ambitious and complex projects were most likely to fail. For projects to be feasible, they had to be modest about the amount of change involved (Moussa and Schware 1992). While ICT may trigger development, some infrastructural and organisational development may be needed first to make ICT projects sustainable and feasible.

Looking at development processes, reasons for failure are context mismatches, which happens when stakeholders and developers from western countries dominate the IS design process in the developing country and assume that a design derived from their own context will work in the developing country as well. Technology transfer from north to south is a complex task, and it can not be seen purely as a transfer of a technical artefact (Braa, Monteiro, and Reinert 1995). Often the transfer includes methodologies, inscribed intentions for use, a comprehensive training process and other non-technical aspects. Such complex projects demand a need for a social systems perspective on information systems, that an information system is seen as a complex system that incorporates social and organisational aspects of its environment (Walsham 1993). Heeks (2002) point out that a successful developing country IS is the one that matches the technical, social and organisational factors of its environment. However, Heeks adds that if the IS exactly matches its environment there will be no change and hence no benefits to draw from the new system. So there is a balance between matching the system to its environment to reduce the possibility to failure, and a certain need for change imposed by the system to assure organisational benefits (ibid.).

How can ICT help improve health in developing countries?

Health is an intrinsic human right as well as a central input to poverty reduction and socioeconomic development (WHO 2003a). Preventable diseases are a tremendous burden to the poor, and while cost-effective methods for bringing these diseases under control exists, there are severe complications in bringing the health services out to the people who need it. Lack of money and system constraints hamper the spread of even basic health services. The Millennium Development Goals, put forth by the United Nations as prioritised overall goals for the next years (UN 2000), include 3 health specific goals, which call for placing health at the centre for development agenda in countries. In a macroeconomic sense, it involves also people and institutions not normally involved with public health to make a shared agenda addressing the financial and systemic constraints in delivery of health and social services.

ICT and health services for development are closely related. Good information systems are crucial in fighting major diseases such as HIV/AIDS, tuberculosis and malaria. Both health services and ICT becomes part of the macroeconomic agenda fighting these diseases.

"UNDP advocates for placing HIV/AIDS at the centre of national planning and budgets […] and promotes decentralised responses that support community-level action."

(UNDP 2003b).

We will in our research focus on Health Information Systems (HIS) that support community-level action in our study of ICT in developing countries.

Why is development important?

Developing countries face huge challenges in many fields. While some countries have managed to develop in the last decades, many developing countries have become increasingly poor due to bad management, unfair trade, huge outstanding loans and internal and regional conflicts. The characteristic of a developing country today is poor education and health services, illiteracy, huge differences between the few poor and the rest of the population, often working in basic sectors as agriculture or production of raw materials. Developing countries rely mainly on agricultural exports or one important natural resource as oil or minerals. This make them vulnerable to the ups and downs of world trade, and as latest emphasised during the WTO meeting in Cancun September 2003 where Brazil, India and China challenged the US and Europe, the protectionist trade policies of the developed countries. Some facts from the HDR 2001 show the situation for the developing countries:

- 1.2 billion people lived on less than $1 a day, and 2.8 billion on less than $2 a day.
- 2.4 billion people do not have basic sanitation, 968 million are without access to safe water.
- HIV/AIDS, tuberculosis and malaria claimed 5.7 million lives in 2001 (WHO, Infectious Disease report 2002)
- 92 percent of the cases of HIV/AIDS are in developing countries
- Malaria kills 3000 people each day in developing countries

The HDR of 2003 shows that the youth literacy rate for the least developed countries are Niger with 23.8% and Burkina Faso with 35.8%. The overall for the Least Developed Countries is 66.3%.

If ICTs can help reduce poverty, it has to be used locally in developing countries. By working with a health information system that can improve quality of life for people, in Cuba, we feel we contribute to both helping people in need, and strengthen local people's qualification in the use of information and ICTs. That is our goal, and our motivation

1.3 Research objectives and approaches to address them

In the previous section, we have given a presentation of our research field ICT and development, and we have seen that the failure rate of ICT and development projects is high. Can this be related to the methods used, the nature of developing countries or the lack of insight and context sensitivity by the researchers and developers, or is it a mix of many factors? Our overall research interest is to study the impediments to development and use of Information and Communication Technologies in developing countries and based on this; discuss appropriate approaches to overcome such constraints in developing countries. We have narrowed down this broad research interest by focusing on one large application area; *health* and one developing country; *Cuba*. Based on the Cuban case study, we will extend the research area to a more international perspective by comparing the Cuban findings with other countries in the HISP network. These research interests are further elaborated into four research objectives:

Research objective 1) *Study the context for systems development in Cuba more generally and within the health sector more specifically*

As we mentioned in the last section, and will outline later in the literature review, IS literature (Walsham 1993, Heeks 2002, Kling and Scacchi 1982) emphasises the importance of context in systems development. In our Cuban case we have applied the same approaches to HIS development as was used in South Africa and also in other countries in the HISP network. We will explore the Cuban context for systems development and compare interesting findings with case studies from the other countries. We have approached this objective through an action research project aiming at developing decentralised health information systems (HISs) in collaboration with the Cuban Ministry of Public Health. Based on findings from this action research project, we explore the field of IS and development countries:

Research objective 2) *Discuss and explore appropriate approaches to systems development and HISs in a Cuban context*

Our task in Cuba has been to develop a health information system (HIS) based on the successful South African HIS following the HISP-approach. This approach includes approaches to systems development, approaches to health systems reforms and HISs, a prototyping database tool, and approaches to organisational change and political brokering. This approach was successfully applied in South Africa, and we will discuss

how these approaches can be adapted to a Cuban context. Based on our findings from the Cuban case study, we will explore more appropriate approaches to systems development in Cuba. In the discussions on adapting the HISP-approach, we emphasise the following aspects:

Approaches to systems development

- these approaches to systems development and design emphasise user participation, leadership to health professionals and managers, local control and bottom-up processes

Approaches to health systems reforms and HISs

- these approaches emphasise decentralisation of information management and local use of information

Approaches to organisational change and political brokering

- these approaches focus on flexibility, improvisation and the ability to adapt the HIS development to the system and infrastructure already in place

Database tools

- the software DHIS is a flexible prototyping tool for designing and developing HISs that support the HISP-approaches to systems development

Then we turn back to the broader research interest and extend the view on systems development processes to a more global context. By comparing our Cuban experiences with similar case studies from other HISP countries we will try to generalise our findings and explore appropriate approaches to HISs and systems development in developing countries. Our third research objective is as follows:

Research objective 3) *Compare systems development experiences from Cuba with case studies from other HISP nodes and explore appropriate approaches to systems development in developing countries in general*

In this comparative study we particularly want to explore the following themes; approaches to systems development, approaches to health systems reforms and HISs, and the processes of organisational change and political brokering.

Many IS development projects in developing countries are understood as technology transfer projects due to export of technology and consultants from developed countries. The notion of *transfer* is criticised by many scholars that look upon IS development from the social systems perspective. The Cuban case study illustrates interesting aspects of technology transfer, and we will use these experiences to explore this concept and its critiques:

Research objective 4) *Present and discuss different perspectives on the term technology transfer*

1.4 Chapter presentations

Part 1 Literature and background

Chapter 2 - Literature review

Here we will outline the theoretical framework for our study:

Information systems (IS)
We review the social systems perspective on ISs, organisational informatics, and approaches to context sensitive IS development.

Information systems and developing countries
Drawing from literature on IS development in developing countries, we present various lessons on the subject. Of special interest for this study are the use of participation, and the problematic processes of technology transfer.

Health information systems (HISs)
This chapter gives an introduction to our implementation area, health information systems. We will emphasise on routine HISs and WHO policies on decentralisation and the district approach.

Chapter 3 - Health information systems programme **(HISP)**

A brief presentation of the philosophy and history of the health information systems programme (HISP) will be given here. We give a short presentation of the other countries in the global HISP network.

Part 2 Methods

Chapter 4 - Methods

In this chapter, we present our research approach. We outline both why we chose the methods we did, and how we conducted the different tasks. A presentation of the researchers involved in the project, and the sub-case descriptions will also be given, along with a discussion of the limitations and pitfalls of our study.

Part 3 Empirical study

Chapter 5 - The Cuban context

Here we give a description of the Cuban context emphasising on social, political, economical and infrastructural aspects of the Cuban setting. In more detail, we explore the ICT situation in Cuba, and the Cuban health system, along with its health information systems.

Chapter 6 - An overview of the Cuban HISP project

This chapter presents a chronological summary of project actions. We also present the objectives for the collaboration project. The political changes in Cuba, which severely

influenced the project, are described, together with implications of the US trade embargo will be describes here.

Chapter 7 - Development of a Cuban HIS

The HIS development process will be described here. We present the database tool, the development approach, prototyping and redesign actions, collaboration and participation with local staff, and training, all important elements of this process. We also describe some infrastructural difficulties, and a give a summary of the different sub-cases from the pilot sites involved in the project.

Chapter 8 - Potential benefits of implementing the new HIS in Cuba

Here we will conduct an analysis based on the data collected in in the prototype we developed to demonstrate the benefits of the DHIS compared to the present HIS. The different features of the software will be used with real data, in a real-life example. Based on the captured data, we will also do an analysis of the data quality in Cuba.

Part 4 - Discussion and Conclusion

Chapter 9 - Discussion

We will discuss our research objectives from chapter 1 based on our empirical findings from Cuba and draw upon relevant theory reviewed in chapters 3 and 4. We discuss the appropriateness of applying the HISP approaches to the Cuban context. Furthermore, we will explore more appropriate approaches for systems development and HISs in Cuba in particular and developing countries in general.

Chapter 10 - Conclusion

In the conclusion we present our main findings related to our research objectives. Here we also give a short evaluation of our own research.

Part 1 Literature and Background

"We have created, but not officially opened –the second year of studies will soon begin –a computer science university with students selected from among the most talented throughout the whole country. Around 2000 students will be enrolled every year, and they will not be the only ones, of course. There, they will be trained more as analysts than programmers."

Speech given by the Fidel Castro Ruz at the Law School of the University of Buenos Aires. Argentina, May 26 2003.

Blblblblblblablalablabal……..

2 Literature review
3 Methods
4 HISP

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2 Literature review

In this chapter we present the theoretical background relevant to our project. Theories and strategies reviewed here will be reflected in our empirical study and then discussed in relation our empirical findings.

We start with a broad view on information systems (ISs) theories where we look into different perspectives on information systems, organisational change related to ISs and strategies on IS development. We narrow down towards our research field by looking at literature on information systems and developing countries, we present development strategies related to this domain and outline different perspectives on the problematic concept of technology transfer. We further narrow down towards our application area by a presentation of health information systems (HISs), where we focus on district-based routine HISs and look at global trends on HIS development in developing countries.

The following sections will be presented:

2.1 - Information systems (IS)
2.2 - Information systems and developing countries
2.3 - Health Information systems (HISs)
2.4 - Summary of literature review

2.1 Information systems (IS)

In this section we review theories on information systems relevant to our research and development project. The social systems perspective on information systems as apposed to the traditional technology deterministic perspective is central in our review. Based in this perspective there are theories and strategies that look into the introduction of information systems in organisations. Social theory like Giddens' Structuration theory is applied in the field of IS to analyse the change processes involved, and development strategies focus on user participation and flexibility and emphasise on taking the context into account.

The following subsections will be presented:

2.1.1 - Information systems as social systems
2.1.2 - Organisational informatics
2.1.3 - Strategies for systems development

2.1.1 Information systems as social systems

Traditional research on ICT understands information systems as discrete technological artefacts, like an information processing application, which use has a predefined and direct effect on e.g. the organisation where it is implemented. In many situations and contexts this pure technological view on information systems has lead to failures, and

its predefined and expected effects have not always been realised in practice (Kling et al 2000). The Social Informatics Report (Kling et al. 2000) uses the term technological determinism on this perspective and explains why it can be inapplicable in information systems:

"*While technological determinism can be applicable and useful in situations that are characterized by high degree of control and short time frames, it has limited value in dynamic and complex situations that unfold over longer periods of time. Technological determinism cannot adequately account for the interactions between ICT, the people who design, implement and use them, and the social and organisational contexts in which the technologies and people are embedded.*" (Kling et al. 2000 p.49-50)

Historically, the relationship between technical and social factors in working processes was first taken into account in the 1950s by English employment sociologists and the term socio-technical systems was introduced. In the beginning of the 1970s computer experts, who up until now only had discussed technical and economical issues, started to get interested in the social, organisational and psychological aspects of computer systems (Bansler 1987). Especially in Scandinavia, scholars presented theories and methods concerning the relationship between computers and humans, and information systems and organisations, and there were political battles fought by unions on how computer systems should be used in organisations. In the 70s and 80s, there were much insecurity around computers and their potential, and there were growing mistrust and scepticism towards computers due to fear of mass unemployment and totalitarian societies where the state control and monitor all citizens' lives, as described in Orwell's *1984*. Høyer (1971) presents a theory on how to fight the resistance among employees against new computer systems, and Bansler (1987) describes Høyer's theory in these terms:

"*It is insufficient to look at an enterprise as a technical system, as humans play a key role in the enterprise's function, and because humans have certain needs and behaviour, that must be taken into account.* [..] *The system engineer has to consider these needs when he designs and implements a computer system.*" (Bansler 1987 p. 90, our translation)

The concept of *web models* (Kling and Scacchi 1982) can be used to study information systems in a social context. Walsham explains this concept:

"Web models draw broad boundaries around the focal computer system and examine how its use depends upon a social context of complex social actions. The models define this social context by taking into account the social relations between the set of participants concerned with the information system, the infrastructure available for its support, and the previous history within the organisation of commitments made in developing and operating related computer-based technologies." (Walsham 1993 p.55)

He continues:

"With respect to the social relations as considered in web models, it is important to note that participants include users, system developers, the senior management of the company, and any other individuals or groups who are affected by the computer-based information system." (Walsham 1993 p.55)

Kling et al. (2000) have produced a comprehensive report on *Social Informatics* in a call for more focus on the social aspects of ICTs. Social Informatics refers to the interdisciplinary study of design, use and consequences of ICTs that take into account their interaction with institutional and cultural contexts (Kling et al. 2000). The report states that the definition of social informatics helps to emphasise a key idea:

"ICT do not exist in social or technological isolation. Their "cultural and institutional contexts" influence the ways in which they are developed, the kinds of workable configurations that are proposed, how they are implemented and used, and the range of consequences that occur for organisations and other social groupings"

(Kling et al. 2000 p.15)

2.1.2 Organisational informatics

In a social systems perspective on information systems there are no clear separation between the information system and the organisation where it is implemented. The two are parts of the same and broader social system and they interact on each other. While the traditional technological deterministic view has focused on direct effects and outputs when introducing an information system in an organisation, the social systems perspective demands a much more complex view on the processes of change involved and the interactions between the information system and the organisation (Walsham 1993). Many scholars have put forward theories on the interactions between information systems and organisations, and *organisational informatics* (Kling et al. 2000) is a term that covers this research area. As a consequence of the difficulties and complexity involved in organisational informatics scholars have started to draw upon fields like anthropology, social theory, sociology, and philosophy (Braa, Monteiro and Sahay 2003), and especially sociologist Gidden's Structuration theory has been helpful in analyzing the social interactions between information systems and organisational contexts (Braa 1997, Puri and Sahay 2003, Walsham 1993).

We will review three theories concerning organisational informatics that are relevant to our case; 1) Structuration theory in IS; 2) Information Infrastructures; 3) IS and Politics.

Structuration theory applied to the field of Information systems

Walsham (1993) emphasise a need to focus on the *processes of change* involved when understanding organisational change associated with the introduction of information systems, as opposed to the technological deterministic perspective that focus solely on the *content of change*. In order to analyse this process of change Walsham (1993) has presented an analytical framework as seen in Figure 1.

The framework consists of four components that cover different aspects of the organisational change process; content, social context, social process, and a context/process linkage.

Organizational change and IS: synthesized analytical framework

Key Components of Change Framework	Associated Conceptual Elements
Content	Organization-products/processes/systems
	Information systems-hardware/software/systems
Social Context	Web Models-social relations/infrastructure/history
	Multi-level contexts
Social Process	Culture-subcultures/multiple meanings
	Politics-control and autonomy/morality
Context/Process Linkage	Structuration theory-action and structure duality
	IS and modalities-embody interpretative schemes
	-provide co-ordination and control facilities
	-encapsulate norms

Figure 1. Walsham's analytical framework

Organisational change and IS: synthesized analytical framework (Walsham 1993)

Content is related to the direct changes on the organisation, such as changes to products, processes and systems, and changes to the information system, such as hardware, software and related technologies. These aspects make up the technological determinist perspective, the content of the change process. Walsham points out the importance of content, but emphasise that there is also a need to focus on other more social aspects that are involved in the change process (ibid.)

The *social context* component includes the web models (Kling and Scacchi, 1982) and thus covers the social relations between the participants concerned with the IS, the social infrastructure in place or necessary to support the new IS, and the organisational history of previously related commitments made concerning information systems. In addition to the web models Walsham includes the conceptual element Multi-levelled contexts to make up the social context. Multi-levelled contexts are concerned with the broader concepts of the IS such as the homes of individuals, city and country-wide contexts. Walsham (ibid.) argues that these broader aspects of context will contribute to a richer social analysis.

Social process involves both cultural and political aspects of the organisation. Culture is concerned with interaction between different user groups and their interpretation of actions and events related to the introduction of the new IS. The political concept covers the role the information systems play in management dynamics in balancing between control and autonomy in the organisation (ibid.).

The context/process linkage is argued to be of key importance to understand the impact information systems have on organisations, and to analyse this linkage Walsham applies sociologist Gidden's structuration theory (Giddens 1984).

The structuration theory (Giddens 1984) aimed at resolving the debate between social theories focusing on the human agents and human actions, and the ones that focused on social structures (Walsham 1993). In Walsham's analytical framework above, this can be understood as focusing on social process (human actions) or social context (social structures).

"This agency/structure debate is resolved by Giddens into a duality of structure, whereby agents and structures are not two independently given sets of phenomena, but represent a duality whereby structure is drawn on in human interactions but, in doing so, social structures are produced and reproduced." (Walsham 1993 p.61)

Walsham explains how the structuration theory is applied to IS:

"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)

Figure 2 illustrates the analytical dimensions of this duality of structure.

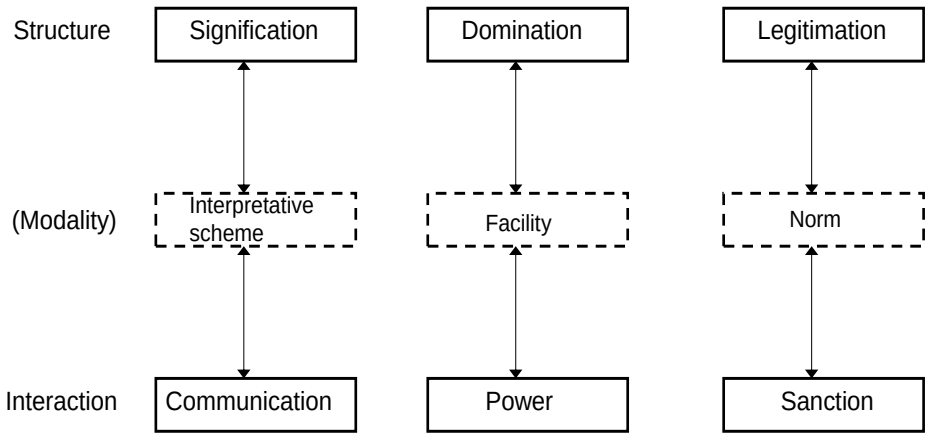

Figure 2. Structuration theory

Structuration theory: analytical dimensions of duality of structures (Giddens 1984).

It is important to emphasise that Gidden's structuration theory is a theory that allows for change, it puts forward the fact that organisational structures can change and that human actors are able to cause this change.

"As is evident from the overall context of my case material, even the most irreversible structure, as the Soviet Union, may change. Structuration theory and the duality of structures (Giddens 1984) explain that even the most irreversible structure may change because they are constructed by social action." (Braa 1997 p.82)

Braa and Nermunkh (1997) use the structuration theory in order to analyse the introduction of a new health information system in Mongolia. The new system is understood as an *interpretative scheme* to cultivate meaning in the Mongolian health system in a slow and incremental process. The present system, the system they seek to change, is viewed as a facility with which the higher central management use to exercise power, and thereby reproduce the centralist structures of domination. The development process seeks to redesign the present system, so that the new system gradually can communicate new norms and values that can help to legitimate new management structures.

Information Infrastructures and Installed base

Hanseth and Monteiro (1998) use *Information Infrastructures* to denote the fact that ISs are something bigger than the traditional system. Information Infrastructures like the *web models* is a notion that encompasses a whole network of human, social and technical components. Hanseth and Monteiro describe the Information Infrastructure as shared, evolving, open, standardised and heterogeneous, and he puts forward the term *Installed Base* to explain how the social system can change:

"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)

This concept implies that information systems are resistant to change and reject drastic changes. The Installed Base embed the analytical concepts of Walsham's framework; the social context, the social process, and the linkage between them are all part of the Installed Base and must be taken into account when trying to change it. Approaches to change the Installed Base must be context-sensitive, and we will review some of these approaches in the next section.

IS and politics

We have already seen how Walsham (1993) uses a political perspective as part of his analytical framework for IS and organisational change. Kling is another scholar who looks at political aspects as part of IS development. Kling (1980) presents different theories of resistance. One such theory is the political variant of the interaction theory (Markus 1983), where resistance is viewed as a product of interaction between the system design and the intra-organisational distribution of power. The actors loosing power will resist the new system, those gaining power will accept it.

Similar perspectives on information as a component of power are described by Kraemer (1979) who states that any attempt to change information flows that results in a loss of power will be resisted, and Buchanan-Smith et al. (1994) that argue that people with different political agendas create barriers to information sharing.

Another perspective that supports the fact that the politics of organisations should be considered as an important element in the *social* IS development process is from Feldman and March (1981), where information in organisations is seen as both a signal and symbol. Empirical studies show that organisations gather more information than they use, and yet they ask for more. Feldman and March (ibid.) have examined several case studies regarding information gathering and use for decisions. What they found could not be justified according to conventional decision theory terms, where information is seen as gathered because it helps make a choice.

Some basic rules can be extracted from their work:

- Much data have little decision relevance for the decision to be taken
- Much data is collected and interpreted after a decision or an important part of such is made
- Much of the data gathered is not used in decision making
- Regardless of the data available when first considering the decision, more information is requested
- Complaints about the lack of information occur while available information is ignored
- The relevance of information for decisions is less obvious than the insistence on information

Four explanations are given to these phenomena:

- Organisations provide incentives for gathering extra information
- Much of the information is gathered and used in a surveillance mode, where data is scanned for surprises as much as it is used to clarify uncertainties
- Much of the information that is found in organisations is subject to strategic misrepresentation
- Information use symbolises a commitment to rational choice

A closer look at the last explanation is useful:
Since use of information is embedded in social norms it is also highly symbolic. Decisions in organisations allocate scarce resources, which make the decision making arena important for displaying authority and expected behaviour. As information use and collection is seen as important for decision making, it has an important symbolic value in these organisations and their decision making processes. Thus, more information is gathered than necessary, and situations listed above take place. Displaying information and explaining decisions are symbols that indicate an ability to use information easily and appropriately, hallmark of a competent organisation. Requesting much information is a signal that the organisation or individual seeks this. Feldman and March concludes:

"Displaying the symbol reaffirms the importance of this social value and signals personal and organisational competence." (Feldman and March 1981 p.182)

2.1.3 Strategies for systems development

The concept of Installed Base, the Structuration theory, and the IS and politics linkage all argue that an information system is closely related to its context, and that a development of a new system must take all aspects of the context into account.

Traditional systems development based in the technological deterministic school is seen as a defined and controllable technical process. The development process consists of clearly defined phases, and the system is developed on the basis of a set of predefined requirements. The waterfall model for systems development is an example of such a process (Sommerville 2001).

Given the social systems perspective on IS, the development process is highly dependent on social, political and organisational aspects of the context where the system is to be implemented. The Installed Base concept argues that a piecemeal and incremental change process is needed and that the context rejects drastic changes. The traditional systems development models based on a technological deterministic view do not fit these requirements of taking the context into account, and they do not seek to develop a system that evolves over time and adapts to the context.

Scandinavian approaches to systems development and user participation

The social perspective on information systems has been a popular theoretical perspective among many Scandinavian IS researchers, and several Scandinavian IS projects have contributed to this research area. User participation in systems development is the main component of the approach and it has been discussed and practised in Scandinavia in the last 30 years. User participation refers to the involvement of users in different activities in the systems development process (Bjerknes and Bratteteig 1995).

Bjørn-Andersen and Hedberg (1977) give three reasons for user participation:

- To improve the knowledge upon which systems are built
- To enable people to develop realistic expectations and reduce resistance to change.
- To increase workplace democracy by giving the members of an organisation the right to participate in decisions that are likely to affect their work.

The first two reasons are targeted at using the knowledge of the workers to tailor the new system to the actual work it is meant to support. The third reason however is more related to cultural and political aspects of systems development, aiming at improved workplace democracy.

Ehn (1993) points out one political and one technical feature that are important with the Scandinavian approach. The political feature is that it raises questions about democracy, power, and control at the workplace, and Ehn characterises this feature as deeply controversial, especially from a manager's point of view. The technical feature Ehn points out is that the approach promises that a participation of skilled workers in the design process can contribute importantly to successful design and high-quality products.

Scandinavian IS research has been project-driven and the main theoretical contributions come from projects. These projects can be organised into three generations; the Trade Union Projects, the design for Skilled Worker, and Use of computers in Organisational Context (Bjerknes and Bratteteig 1995).

A project initiated by the Norwegian Iron and Metal Worker's Union is amongst the most recognised IS projects in Scandinavia.

"The objective was to apply a workers' perspective on development and introduction of new technology in order to produce an action plan that would represent and strengthen the workers' position with respect to the introduction and use of computer technology."

(Bjerknes and Bratteteig 1995)

The trade union approaches in the first generation did improve workers influence on technology, but to increase this influence further the next generation focused on developing technological alternatives that could influence the content of the work processes (Bjerknes and Bratteteig 1995). The UTOPIA project, a laboratory-based project where IS researchers and Nordic Graphical Union members collaborated in designing a computer system for graphical workers, is an example on how skilled workers can participate in the design process (Ehn and Kyng 1986). During the research a design approach called "design by doing" was developed, which involved using mock-ups and simulations of the computer system to let the skilled graphical workers express their skills and knowledge through actual work using the simulations rather than having to express their opinions explicitly (ibid.).
While the UTOPIA project was a laboratory-based project, a fact that may have weakened its possibilities to change real life work situations, the third generation's Florence project focused on a design process at the application area, on IS development in context (Bjerknes and Bratteteig 1995, Braa 1997). The project aimed at designing a system to support the work processes of nurses within a hospital ward by involving the nurses as skilled participators in the design process. *Mutual learning*, a process where both the users and designers get knowledge from each other, was considered essential in this project (Bjerknes and Bratteteig 1995). Ehn (1993) argues that a mutual learning process between future users and developers/trainers is important to reduce communication problems during design and implementation.

Furthermore, the project experienced that

"A computer system for the organisation as a whole realises a compromise between the interests and the needs of a variety of user groups." (Bjerknes and Bratteteig 1995 p.81)

To achieve such a compromise there is a need of balancing the interests among employees and management, or even within a small group of workers at the same level, as interest conflicts arise at all levels (ibid.).

Greenbaum and Kyng (1991) build on participation experiences in the Scandinavian projects from the 80s and put forth some new perspectives on participation. *Cooperative* design, defined as empowering users to fuller participation and cooperation in the development process is a key issue.

"Users, as well as professional designers, have knowledge and skills that are central to the design of useful computer applications; therefore, design needs to be organised as a cooperative activity between the users and the designers."

(Greenbaum and Kyng 1991 p.143)

Strategies for achieving a cooperative process emphasise that the design must be carried out at the work place taking work practices and human actors seriously. A shift of focus towards supporting the specific work tasks of the users, illustrations of potential effects of the new system with the use of tools familiar to the users, and efforts to envision future work situations that help the users to see how the design affects the work practices, are factors that help to establish a *cooperative* design process and commitment of the users (ibid.).

User participation is widely acknowledged as a development approach also outside Scandinavia; Heeks, Mundy, and Salazar (1999) argue that participatory approaches that allow the worldviews of a range of stakeholders to be incorporated into the design can help aligning different objectives and values. Combining or compromising between hard, rational worldviews can be difficult since these views are often resistant to change, but despite this fact, participatory approaches have proven to be the bedrock of successful HCIS projects in a wide variety of settings.

Walsham (2002) argues that communication and cooperation between the users and the developers/trainers is the foundation upon which an IS is designed and used. He stresses the importance of a detailed and continuous process of learning between the different actors involved in design and training, to address, and work with the limits and requirements of various actors.

Grudin (1991) outlines that the user participation strategy focus on the involvement of the users at all stages of the development process, to ensure that the users evolve a sense of ownership towards the system.

Prototyping

Traditional development methods as e.g. the waterfall model with an unvarying sequence of phases from requirements to the final implementation is not flexible enough to cater for user involvement and new requirements that may come up at any stage in the development process (Grudin 1991). User participation demands a looser and more flexible method that allows feedback from the users at any time in the development process and not only in an early requirements phase. Prototyping is a method that supports such a communicative development process, and is thus an important tool in participatory design.

Sommerville (2001) mentions three approaches to prototyping; exploratory, experimental and evolutionary. The exploratory approach is mostly used early in the development process to clarify the needs of the users by using prototypes as tools to simulate system processes. These prototypes are usually thrown away and not part of the final system. Experimental prototyping is used to support quick user evaluation by experimental use of the proposed system at any phase in the development process (ibid.).

Buddhe et al. (1991) describes the evolutionary prototyping strategy of IS development as a continuous process for adapting an application system to rapidly changing organisational constraints. Furthermore, the software development is no longer seen as a self-containing project, but rather as a process continuously accompanying the application. The developers become technical consultants that work closely with the users to improve the application system. This strategy is typically carried out by developing *pilot systems* (ibid.), a sophisticated first draft of the system that is later improved and incremented in cycles. All improvements are done in close collaboration with the users and geared at designing suitable solutions for use in the application area.

Both the UTOPIA and the Florence projects used a prototyping strategy to facilitate the user participation in the design process. In the UTOPIA project they used a exploratory prototyping method with mock-ups that helped the researchers to communicate with the graphical workers and to quickly incorporate new needs into the design (Bødker et al. 1986). In the Florence project the prototyping strategy helped to reduce misunderstandings between the researchers and the skilled participatory workers and to clarify the needs of the nurses (Bjerknes and Bratteteig 1986). Pape and Thoresen (1986) describe another Scandinavian project were prototyping was used as a development method, and where the system was developed in an evolutionary way with several improved prototypes leading to a final product. They emphasise the importance of a trial and error process that facilitates the use of different solutions to solve the problems that arise. Other reflections by the researchers are that the process of involving users in the development process is challenging, and that there is a need for involving all kinds of users in the learning phase, and to let them develop and use new skills (ibid.).

Bødker and Grønbæk (1991) propose *cooperative prototyping* as a tool to support the cooperative design approach (Greenbaum and Kyng 1991). The approach seeks to establish a cooperative process where the users and the designers are equally active and participative drawing on their different skills, as apposed to the traditional approach where the designers are in charge and utilise the requirements of the users.

"To facilitate such a process, the designers must somehow let the users experience a fluent work-like situation with a future computer application; that is, the users' current skills must be brought into contact with new technological possibilities."

(Bødker and Grønbæk 1991 p.200)

Selecting a competent group of participators is a crucial process, but often this is not within the control of the designers, and instead determined by organisational power relations. While many different types of user groups seem to be potentially good participators, the most important thing is establish a working group with competent user representatives (Bødker and Grønbæk 1991).

Braa and Hedberg (2002) describe a development process from South Africa where they experienced that formal prototyping with well established users groups (Buddhe et al. 1991) was difficult to achieve in the floating political environment in South Africa after the fall of Apartheid. Therefore, a looser way of organising prototyping where any interested or innovative user regardless of position in the hierarchy had full access to the development team was put forward to provide improvisation and flexibility.

Cultivation

Dahlbom and Janlert (1996) propose the concept of cultivation as opposed to construction, and Braa (1997) describes how they apply cultivation in the field of IS:

"Cultivation denotes a way of shaping technology that is fundamentally different from rational planning, engineering methods and construction of technology. Cultivation is about interfering with, supporting and controlling natural processes that are in the material, "the tomatoes themselves must grow, just as the wound itself must heal,.." [..] Cultivation is used as opposed to construction, in order to emphasise that the process of change needs to be based on what is already existing. "

(Braa 1997 pp. 18 and 88)

Braa (1997) argues that the information system is cultivated from and by the social system in question and will thus be expressed within this culture. 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)

Hanseth and Monteiro (1998) propose cultivation as a long-term piecemeal design strategy to change the installed base. Cultivation requires a close analysis of the way behaviour is inscribed in the already existing elements of an infrastructure, the installed base, and this knowledge is then used when designing the new system (ibid.).

Coverage as a design strategy facilitating cultivation

When cultivating an information system based on the installed base, it is important for the new system to fully cover the routines of the existing system. Thus the design of the new system must support the information structures and information flows facilitated by the existing system. Without this coverage the new system is less sustainable as it becomes less useful (Braa, Monteiro and Sahay 2003)

Challenges and constraints with participatory approaches

A user participatory process can be understood as a controversial in the way that it seeks to ensure workplace democracy and involve users that are often left out of the decision-making process, and there are challenges and constraints related to such a controversial approach.

Participatory approaches tend to be more difficult in contexts with a strong bureaucratic structure, and Braa, Monteiro, and Sahay (2003) describe an IS project in India where a democratic bottom-up strategy could not be facilitated at a local level before such an approach was sanctioned at the top level.

In the UTOPIA project the democratic effect of the participatory process was later questioned since the new system did not equally favour all user groups, a result of an

uneven participatory design process where not all stakeholders were included (Bjerknes and Bratteteig 1986).

Heeks, Mundy, and Salazar (1999) point out an important reflection when applying context sensitive approaches to systems development that also holds for participatory approaches. The focus in such approaches tend to be on matching the IS to its context, and not so much on matching IS implementation techniques to their context.

"We can say that implementation techniques are less likely to work where there is a gap between the conceptions inherent within those techniques and the realities of the organisation in which you try to apply them" (Heeks, Mundy, and Salazar 1999 p.20)

In the case of user participation, the focus is on involving the users in designing a tailored-made solution that fit well with its context, but it might be that the context for political, cultural or infrastructural reasons does not make user participation possible.

Heeks, Mundy, and Salazar (1999) have made a list describing contexts where user-participation techniques are unlikely to work well:

- 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 organisation are authoritarian and hierarchical
- Users lack the skills and confidence necessary to engage in participative processes
- The management style and organisational structures of the organisation are highly centralised
- The organisation lacks the time and money to invest in participative approaches

(Heeks, Mundy, and Salazar 1999 p.20)

This context that Heeks, Mundy and Salazar describe is often found in centralist and hierarchical organisations, where the management is not likely to support a democratic approach involving employees at the lower levels. They use the fact that the users lack information about participative techniques and about the new system to explain difficulties of participation. As opposed to this view, we have earlier described how the participatory approach seeks to enhance this understanding in a mutual-learning process (Bjørn-Andersen and Hedberg 1977, Ehn 1993, and Walsham 2002). An important objective is to involve a wide range of different users so that the large group of participators together make up the skills and knowledge needed for building the new system. Clearly, with a limited selection of participators, that can be the case in centralised contexts, the same range of skills and knowledge is difficult to obtain.

2.2 Information systems and developing countries

Walsham, Symons and Waema (1990) argue that methodologies that aim to provide an understanding of the organisational, social and political context are highly suitable for organisations in developing countries. The aspects of culture are often ignored in the developing process, but have great influence on how the system will work. This is

especially important when people foreign to the particular culture is involved in the organisation or the development. In many developing countries culture varies intra-nationally. He argues that culture should be understood through immersion, and that culture should not be seen as a barrier to technological and organisational development (Walsham 2001).

Braa (1997) strengthens this view and puts forward some contextual constraints of developing countries that he uses to exemplify why the social system model is crucial in system development in developing countries:

- Informal problem areas, not as formalised as in developed countries
- Few computers, little ICT experience, support/training will have to be established during the development process.
- ISs are more social systems due to the typical scenario "40 people, 20 units and 1 computer"

Furthermore, Braa (1997) argues that strategies from the Scandinavian approaches to systems development also can be applicable in developing countries. He states that IS development in developing countries needs to be process-oriented, bottom-up, based on a social system paradigm, and focus on the local scale and the community, and that all these needs comply well with the central issues in the Scandinavian approaches. He points out that the focus in the Scandinavian approach always has been on the local scale, process, empowerment and learning.

Heeks (1999a) explores the effect of participation in developing countries, and he points to several factors limiting the value of participation. One such example is cases where participation is not really participation, where the culture and politics in an organisation prevent participative outcome from apparently participative processes by constraining who can say what and how within different groups (Biggs and Smith 1998). Participation should therefore be approached with some caution. Other examples are when people are chosen to participate, or the participators have a heavy workload. Ignoring the reality that members of organisations have heavy workloads may result in resistance to participation, or frequent cases of stress and burnout (Dockery 1998).
Heeks sums up:

"More generally, it is clear that participation needs to be approached far more critically and without the assumption that it will always and necessarily bring benefits either to development projects generally or to IS development projects more specifically" (Heeks 1999a p.11)

Biggs and Smith (1998) give a framework for analysing participative methods:

"It is important to look at what is going on around the techniques themselves if, as suggested here, the main determinants of outcomes lie not with the choice of method but with the institutions and protagonists in which those choices are made"

(Biggs and Smith 1998 p.245)

For IS projects to persist over time, they need to be sustainable. Following this, Korpela (1994) calls for an *industrial fabric* of maintenance, training and development. A software project may be successfully developed, but later abandoned due to lack of

knowledge to maintain it and continue development. Korpela et al. (2000) argue that there is a need for IS development methodologies for severely constrained conditions locally in Africa. If systems are going to be designed in developing countries, there needs to be locally adapted *methods* too. Results from a study in Nigeria suggest that the methodologies must be highly practicable for developers with less IS education facing severe constraints. Local competence has to be developed, and management and community involvement are seen as the main stakeholder groups in addition to IT users and developers.

Mursu et al. (1999) have conducted a risk study in Nigeria regarding IS development. They conclude that many of the risks do not differ significantly from the risks revealed in similar studies of Hong Kong, USA and Finland. But many "new" risks were identified, most related to poor infrastructure, and the difficult political and economical situation. The risk factors of software development projects may not differ very much between Nigeria and other developing countries (Korpela et al. 2000).

2.2.1 Critics of the term "Technology Transfer"

As mentioned, the technological improvements to communication and economical development follow a path of duality. The first world countries have been the forerunners in the technological drive spurring the globalization of information and markets, and the developing countries have been left behind (Castells 1998, Giddens 1999). Governments and organisations, like the UN, have stressed the need to help developing countries catch up. The process of doing this, with the use of first world developed technology or with the help of agents from the developed world, has been labelled technology transfer.

Dore (1984) defines the process of technology transfer as the effort of getting knowledge that is only in the head of some foreigners to the practise of the nationals in developing countries. Odedra (1990) sees the process as transferring knowledge on how the system works, how to operate it, maintain it and assemble the different components of it.

Braa (1997) speaks of horizontal and vertical replication. Horizontal replication is diffusion to, and cultivation of new places, while vertical replication is cultivation of the system development process at the same place, or in new levels above or under it. For horizontal cultivation, he uses the metaphor of sowing a seed. The soil has to be prepared, the seed and sprouts nourished and watered to grow and get sustainable. This diffusion by cultivation makes it possible to diffuse technology to different contexts.

Challenges and constraints for technology transfer

Odedra-Straub (1990) points too the fact that little information technology is transferred to the African developing countries. Equipment is brought into the country without the necessary knowledge about how to use, operate or maintain it.

Heeks (2002) states that the failure rate of IT projects in developing countries is higher than the 75% failure that is found the western world, and that this also applies to projects were technology is brought from industrialised countries to developing countries. Based on the ITPOSMO model (Heeks, Mundy and Salazar 1999) Heeks

argues that many of the failures are due to design-reality gaps. Northern designs are transferred to southern realities, creating a gap between the context the system is designed for and the context in the recipient country. These gaps can be of all kinds, some examples are culture, organisation, information use, power structures, knowledge level, infrastructure etc., or more likely, a combination of several of these.

Since the history of technology transfer and development in developing countries show so many examples of failure, Walsham (2001) emphasises a context sensitive approach, focusing on the entire context when introducing and developing systems in developing countries. The fact that IS development approaches must be sensitive to the local context is backed up by Rohitratana (2000), who illustrates this by an example from Thailand where aspects of the Thai culture prevented the organisational change necessary for the development of a management IS to succeed.

Sahay and Walsham (1997) state that the process of technology transfer, in addition to a transfer of commodities like software, hardware, money and consultants, is laden with the transmission of values, histories and assumptions on how work should be done. The transfer is thus not neutral and value free as it imposes these values on the recipient along with the objective commodities.

Kaasbøll and Nhampossa (2002) have evaluated a technology transfer project in Mozambique where the technology did not originate in a developed country, but in its neighbour South Africa. The technology transferred was the same HIS as we have worked with in Cuba. This south-south transfer had several benefits. It had already been developed by donor funding, in a developed country. No commercialization had taken place, and the software was free. The code is open source, enabling students and other interested parties to help reduce the high consultancy fees when changing the software. The system had been designed to function on old computers without connection to any network, enabling data communication by messengers on foot with floppy disks. Still, in spite of the similarities in culture and technological capabilities, problems arose. All transfer has to include some adaptation, which is expensive and problematic wherever located in the world.

Baark and Heeks (1998) differentiate between two types of projects where such transfer takes place, one being general development projects were technology can be one of several means to access a certain problem, the other being IT-specific projects were the goal is to strengthen the technological capability of the IT producers in developing countries. The HIS project in Cuba that we have been part of, is an example of the former, using ICT to improve the health services.

Baark and Heeks (1998) propose a lifecycle for technology transfer, based on practical experience from four projects in China. The lifecycle is shown in Figure 3.

- The cycle starts with choice of technology, which can often be done during the formulation of the project. Requirements are identified, technological solutions are surveyed, and a decision is taken to obtain certain technology.
- Purchase and installation. This phase can include some training and consulting.
- Assimilation and use. Here the people who work with the new technology must know how it works, how to use it, and how to maintain it.

- Adaptation is the phase where the local people are adapting the technology to local conditions, like adding functionality or improve existing performance. Adaptation is not always present, hence the line from assimilation and use direct to choice. In IT specific projects, this phase is seen as a fundamental part of the project.
- Diffusion and/or innovation can take place when the recipients master the technology. They can spread the technology to other organisations or even sell new innovations locally or globally. While this is often the intentions with IT specific projects, it seldom happens in a general development project.

As new technology can be introduced at any time during the process, it is a cyclic rather than linear process. The arrows pointing at "Choice of technology" from both "Assimilation and use" and "Adaptation" illustrate such an introduction of new technology and the start of a new cycle.

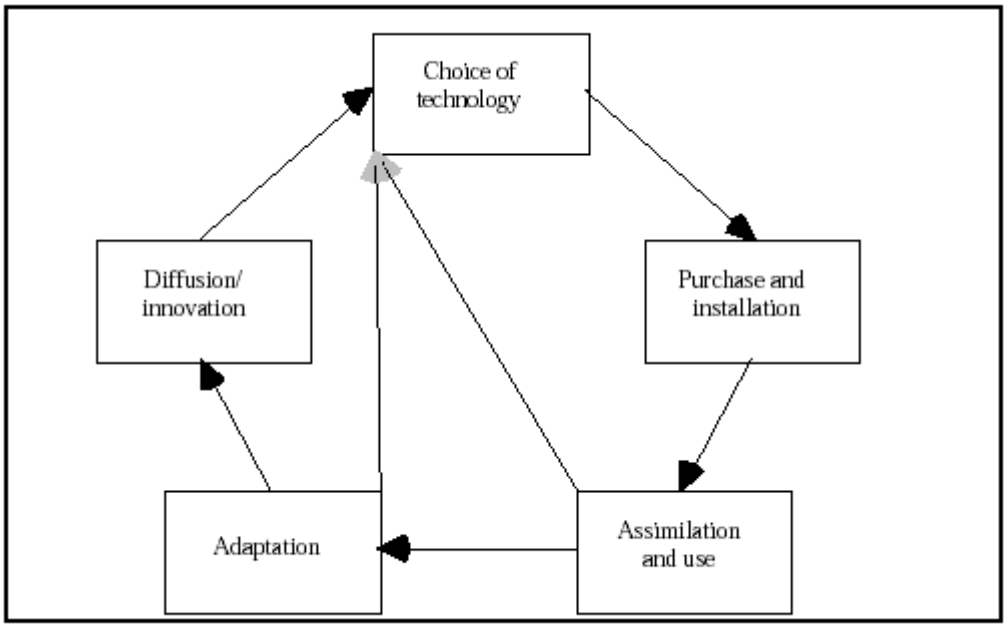

Figure 3. The Information Technology Transfer Life-cycle (Baark and Heeks, 1998)

While Baark and Heeks (1998) look at IT transfer in general, Kaasbøll and Nhampossa (2002) discuss the transfer of information systems. ISs tend to be more sensitive to the social context, and this implies that more adaptation is needed than if just transferring ICT infrastructures or tools. Another point made regarding transfer of information systems is that the assimilation phase often involves organisational change as a change in organisational routines or managerial practices take place when introducing a new system. In the case described by Kaasbøll and Nhampossa (2002) a prototyping strategy with a trial and learning process was used when adapting the system, which meant that assimilation (which includes learning) and adaptation happened in parallel.

Using the social systems perspective, technology transfer can not be seen as just the transfer of some technology. An information system understood as a social system cannot be transferred physically in the same way as a software application or a computer. All technology is embedded in a social and cultural context, making the

transfer of just the technology problematic (Braa, Monteiro and Reinert 1995, Braa 1997);

"Technology is not just an isolated machinery or artefact, but involves the social and cultural context of use of a technical artefact." (Braa, Monteiro and Reinert, 1995)

Technology transfer vs. technological learning

Braa, Monteiro and Reinert (1995) criticise the term technology transfer, and argue that technological learning is a better notion. They emphasise that "transfer" also involves the development of knowledge and skills to use and "master" the technology in its "new" context of use. This ongoing learning process, they argue, needs to include all aspects of development, maintenance and use as well as the development of institutional capacity to sustain the technology. Developing countries thus need to develop appropriate networks of support and maintenance as well as institutions to carry out the

Since the contexts of use and development differ between e.g. Africa and the industrialised countries, Korpela et al. (2000) argue that the methods in systems development also need to be adapted to better suit the specific context in developing countries. Africa needs methods in systems development that are appropriate in Africa and such methods need to be developed through local practice and experience, thus adding further to the notion of learning in technology transfer and systems development and use.

Castells (1996) argues that efforts of technology transfer should aim for sustainable development, thus supporting the view that local knowledge should be at such a level that software and hardware can be maintained and repaired.

The technology needs to be learnt and mastered, since there is no other way to obtain sustainability when the foreign agents leave. Social studies show that all users shape and adapt systems in ways which were not planned (Bijker and Law 1992), and this strengthens the idea that technology can not be transferred and put into use as initially planned. It has to be learnt, and each case is special and unique. When using the term technology transfer, we do not denounce the above ideas, more the opposite, but simply stick to the term used in most literature on the subject.

Translation rather than transfer/diffusion

In a critique of the notion of technology transfer as only including diffusion of technical artifacts, Law (1997) argues that the process should rather be seen as processes of successive translations. Law argues that there is no such thing as technology transfer. Technologies do not originate and spread out, but are passed on, virtually from hand to hand. During this process both technology and contexts of use are gradually changing.

Law uses Actor-Network Theory to describe the processes of translation. In this theory society is regarded as a socio-technical web with actors of all types, both human and non-human. Technical objects are regarded as actors alongside humans and other non-human "things" in heterogeneous networks (Latour 1987, Callon 1991, Braa and Hedberg 2002). Using actor network theory, whatever is taken from its original context

of actor networks and placed in another context will become part in other actor networks and its meaning and agency will therefore necessarily start to change;

"As an alternative to innovation diffusion, a theory of innovation translation offers an approach to explaining innovation that does not rely on any supposedly innate nature of the innovation, or specific characteristics of the change agents or society, but rather on a process of network formation in which all actors seek to persuade others to become their allies in promoting the acceptance of their own view of the way the problem can best be solved." (Tatnall and Gilding 1999 pp. 962-963)

The new actor network will change too, but the important point is the change of what is transferred. Thus a *translation* takes place when it is passed. What is transferred is *translated* to the new actor networks. The technology also creates new actors, and thus new actor networks (Akrich 1992). She uses an example from Nicaragua, where a machine from Sweden was installed to make briquettes usable for fuel in the industry. The machine used bark, offcuts and sawdust from the Swedish forest industry to make briquettes, but the forest in Nicaragua was far away and held by the Contras guerrilla. It was experimented with several materials, and cotton waste was fine for making briquettes. A machine for collecting cotton waste was brought from Sweden. But the cotton season is short, compared to the everlasting flow of forest waste in Sweden, so cotton waste had to be stored to ensure a steady supply. A cotton pest then emerged in the stored cotton waste, changing the waste to dust. The waste had to be compacted before storage to keep the pest away. When everything worked fine, and nice briquettes were made, it turned out that the Nicaraguan industry had no use for it. But the briquettes found its market in bakeries, for which the new fuel was excellent. The final use of the machine, and the networks of actors surrounding it, had become quite different than in Sweden; the technology had gone through successive processes of translations until it had stabilised and found a form and functionality (i.e. translation) appropriate to the Nicaraguan context.

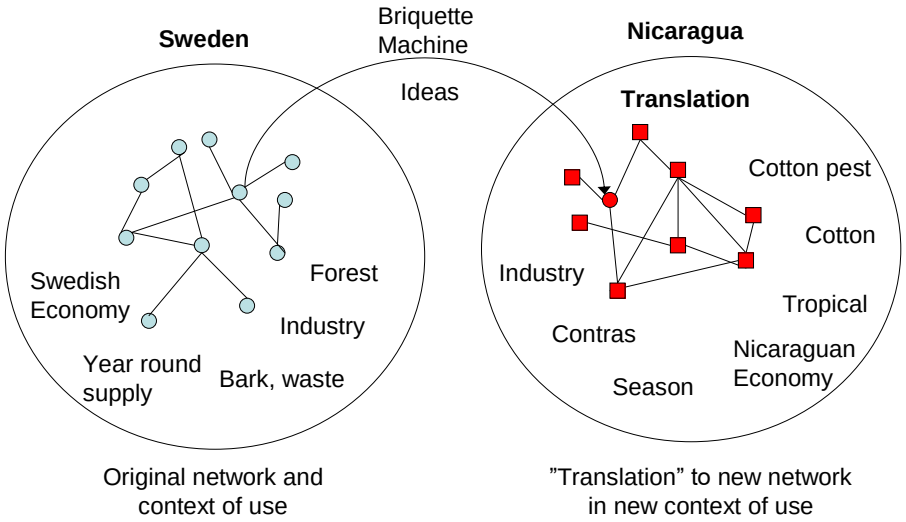

Figure 4. The transfer of technology to a new context.

Figure 4 shows how the actor networks the Swedish machine was a part of are totally different in the new setting. The formation of new actor networks represents translations of the "foreign" technology into a new context of use. Most aspects of the technology have changed; raw materials, products and the use of these products.

This example illustrates well the complexity and wide range of the term technology learning presented in the previous section. The processes of learning have to encompass adaptation of the technology in a new context with different needs and prerequisites than the original. The process of adaptation includes improvisation and (re-) development as well as the establishing of knowledge and routines for support and maintenance, inventing new raw materials, trials and errors, pre-processing of the new raw materials, invention of new areas of use, logistics etc.

In an earlier section we presented the term cultivation as an approach to systems development emphasising improvisation and a strategy to build the new systems on resources and materials already present. This strategy is very similar to the process of translation, adaptation and learning described in the case from Nicaragua. The terms cultivation, learning and translation are relative parallel since they may be used to denote different aspects of the process of technology adaptation and appropriation.

2.3 Health Information systems (HISs)

"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)

The following subsections will be presented:

2.3.1 - The (routine) health information system
2.3.2 - Primary health care and the district health system
2.3.3 - District-based health information systems

Definitions

Boerma defines an HIS as:

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

It is interesting to notice that Boerma's definition aligns perfectly with the social systems perspective reviewed in section **2.1.1**.

Another definition of an HIS is:

"A set of tools and procedures that a health program uses to collect, process, transmit and use data for monitoring, evaluation and control." (EQUITY Project 2001)

Heywood, Campbell, and Awunyo-Akaba (1994) argue that it is important to look at the HIS as a tool for improving health care, and not as a solution itself. AN HIS 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) suggest that an HIS 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

Types of health information systems

We classify two main groups of health information systems:

- Clinical health information systems
- Routine health information systems

Clinical HISs are typically large and complex hospital information systems that focus on patient specific data. These sophisticated health information systems that are often large hospital systems have proven to be difficult to develop both in developed and developing countries, and about three quarters of these systems have failed (Littlejohn, Wyatt and Garvican 2003, Heeks and Bhatnagar 2001).

In this thesis we will focus on routine the routine HIS, the type of HIS we have developed in Cuba. When using the notion of health information systems (HISs) in this thesis, we mean routine HISs.

2.3.1 The (routine) health information system

The Routine Health Information Network (RHINO 2002) defines routine health information as:

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

Examples of routine health information systems are (ibid. p 2):

- health service statistics for routine services reporting and special program reporting (malaria, TB, and HIV/AIDS)

- administrative data (revenue and costs, drugs, personnel, training, research, and documentation)
- epidemiological and surveillance data
- data on community-based health actions
- vital events data (births, deaths and migrations)

An important strength of routine HISs is that they put data directly into the hands of the decision makers and managers at all levels of the health system. This information is especially useful in health planning and management, as it empower practitioners and managers to identify problems as they arise and solve them (ibid.).

The HIS is closely linked with the health system it supports, and as Lippeveld and Sauerborn state:

"A health information system can not exist by itself but as a functional entity within the framework of a comprehensive health system that offers integrated health services, including curative care, rehabilitative care, disease prevention, and health promotion service." (Lippeveld and Sauerborn 2000 p.17)

A national HIS that is used at all levels in the health system needs to represent the same hierarchical structure as the health system, and support each level:

"The healthcare information system structure should permit generation of the necessary information for rational decision making at each level of the health system, each of these levels has specific functions that require specific decisions to be made."

(Lippeveld and Sauerborn 2000 p.3)

The RHINO (Routine Health Information Network) 2002 workshop state the following on how to develop such a system:

"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 the ownership of systems" (RHINO 2002 p.3)

We can see how these suggestions align with the IS literature on user participatory approaches reviewed earlier (**2.1.3**), where many of the Scandinavian projects promoted that systems developers and skilled workers should work closely together in system design.

2.3.2 Primary health care and the district health system

The concept of primary health care (PHC) was born at the WHO and UNICEF conference in Alma-Ata in 1978. The Alma-Ata declaration presented a comprehensive approach to reach the WHO's health for all by the year 2000 goal. The declaration states:

"The Conference strongly reaffirms that health, which is a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity, is a fundamental human right and the attainment of the highest possible level of health is a

most important world-wide social goal whose realization requires the action of many other social and economic sectors in addition to the health sector." (WHO 1978 p.1)

The introduction of PHC marked a shift in health focus from the larger hospitals to health centres and from curative to preventive health care. Article VI in the Alma Ata declaration explains the concept of PHC:

" 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 p.1)

The PHC concept was criticised for being too comprehensive and ambitious, and difficult to implement. Braa (1997) writes about the selective versus the comprehensive PHC debate that followed the Alma Ata declaration. The selective approach stressed a narrowing of the PHC concept and supported selective, vertical and fragmented health programs. Scholars supporting a comprehensive PHC approach argue that the selective approach is not sustainable and stress a need for community empowerment, focus on process, and the need for multi-sectoral approaches (Rifkin and Walt 1986). Braa (1997) argue that strong forces are pulling development of health services, and thus health information systems, towards selective, vertical and fragmented approaches aiming at central control.

Following the Alma Ata declaration several national attempts to implement a country-wide PHC approach failed because the countries were too large and the tasks too complex and expensive to manage centrally (WHO 1995). Several workshops and discussion on how to implement the PHC concept led to the Harare Declaration that demanded intensified primary health care in a well-organised district health system. The health district were to be established as the operational unit for the identification of those who were not receiving full health care, and implementation of strategies to improve the health situation of the entire population (WHO 1995). Furthermore, the declaration considered the health district as the most suitable operational unit to implement the PHC strategy in line with the Alma Ata resolutions.

WHO (1995) lists some characteristics of the health district system:

- A defined administrative area with a population of approximately 50 000-300 000.
- A segment of the national health system.
- It comprises all facilities and individuals in the district who are involved in health care at the various intervention levels, including not only governmental, but also church, charity, and private health care providers.
- The vertical programmes (e.g. immunization, family planning or AIDS control) should be coordinated with the horizontal health services and integrated as far as possible, at least at the primary level.

Amonoo-Lartson et al. (1984) pinpoint an important aspect of the PCH and health system concepts, the local variety:

"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 1984 p.15)

They also suggest an approach on how to deal with this variation:

"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 1984 p.16)

2.3.3 District-based health information systems

Here we will show how the model of health district system suggested by the WHO can be supported by a routine health information system, and how this district-based HIS can become an integrated part of a national HIS.

As the notion of health district integrates all local health activities, an information system supporting the health district has the same demands for integration of health data.

In a HIS, the data is typically collected at each facility at a daily basis and reported to the district information centre (or similar information handling unit) at a routinely basis. Reporting frequencies can be weekly, monthly, quarterly, every semester or once a year. PHC data is usually reported every month. Ideally the district information centre integrates all health information within the district and is responsible for data processing and transmission upwards. In our case study from Cuba, the information centre is represented by a separate health statistics unit.

Action-led health information system

The introduction of PHC introduces some new challenges for HIS in contrast to the traditional HIS focusing on retrospective analysis at a higher level. PHC demands an analysis and use of information immediately and at the same level where it is collected (Opit 1987). Sandiford, Annet and Cibulskis (1992) add that while the traditional approach to HISs has been data-led, where the data is an end in itself, an action-led approach, where information is used to influence action, is needed for an HIS supporting primary health care. In a data-led system, data is collected just because the higher level requests it, and such a system is designed by central levels to support control and monitoring. In contrast, in an action-led system, one only collects the data that is needed for appropriate management and appropriate decision-making (Sandiford, Annet and Cibulskis 1992). This view data collection and information use aligns well with the conclusions of Feldman and March (1981) who studied information use in more general terms (ref. 2.1.2), and found that much of the data gathered by organisations is never used in decision-making.

Furthermore, action-led systems collect a minimal amount of data, focuses just on locally relevant data, and use denominator data as e.g. population as part of action-driven indicators. To a district health information centre, this would mean less data to process, a greater focus on important data, and a more effective and targeted analysis of action-led information.

Local adaptation in a globally standardised system

Due to the local variations found among different health districts Braa, Heywood and Shung King (1997) stress the need for locally adapted HISs for districts. A challenge that arises with many local adaptations is to integrate these locally adapted systems into one consistent national HIS. To achieve such integration, using common standards is essential. When developing these standards it is important to balance between local and non-local needs in each local adaptation (ibid.).

The problem of too much aggregation

How data is captured in the HIS is important and largely decides how useful the data is for local levels. A common problem with national HISs is that the data are so aggregated that the local information disappears in large totals and become useless to lower level management. Opit (1987) points out that by aggregating data to higher levels, local information is lost, and that this can be used as a tool to hide failures or inadequacies in health care systems.

One reason for aggregating data to higher levels is bound to paper-based systems where forms are used to report data upwards in the hierarchy. Keeping data at a detailed low level while reporting upwards in the system, demands an extensive use of forms and time, and finally, to manage all this detailed data at the national level would require a comprehensive system. By aggregating data to larger groups of population, there are fewer forms to fill out, much time is saved and it is easier to get an overview of the situation at the top levels.

With computerised HISs and computers at lower levels in the health systems, the possibility to keep low-level data is much bigger. With computers at each health facility, the data entering process is shared by many, and detailed local information can be stored in the information system.

Information use and feedback

An important step towards the district approach and a decentralisation process in the health system is an increased local use of information. A common problem with HISs is that they are designed to support top-level monitoring, and not to produce information for local decision-making. HISs serve as ways of maintaining bureaucratic or organisational power (Opit 1987). As the health systems around the world are decentralizing its structures and implementing the district-model suggested by the WHO, it is important that not only the structure, but also decision-making and power are decentralised.

Braa (1997) emphasises the importance of involving local role-players in the process of defining goals, targets and indictors, and that they become part of the plan to achieve

these targets. In a health district, the district information centre should provide monthly reports that are fed back to all integrated instances as well as reported upwards to higher levels (Heywood, Campbell and Awunyo-Akaba 1994).

2.4 Summary of literature review

Information systems

We have seen how a social systems perspective on information systems can help us to understand the complexity of information systems and their relations to the broader context. Common for all this literature is the view on information systems as something more than just technical artefacts, seeing IS as a complex system also including contextual issues like politics, culture, human processes and organisational structures.

This social systems perspective argues that organisations and information systems are closely related and that they affect each other. Organisational informatics seeks to understand this relationship, and concepts like the structuration theory, installed base, and IS and politics are put forward to analyse the change processes associated with organisations and information systems. They all argue a slow and context-sensitive change process, and user participatory approaches, evolutionary prototyping, and cultivation are all important context sensitive strategies to systems development. The Scandinavian approaches to systems development incorporate these ideas.

In Table 1 we sum up the main theories and strategies in the IS literature review.

Perspectives on IS	IS and organisational change	Strategies for IS development
IS and context	Installed base	Scandinavian approaches
Web models	Structuration theory in IS	User participation
ISs as social systems	IS and Politics	Cultivation
Social Informatics		Evolutionary prototyping
Information Infrastructures		

Table 1. Summary of IS literature review

IS and developing countries

Methodologies that aim to understand the context is highly suitable for developing countries. The social systems perspective helps to understand the importance of the context and, since many IS in developing countries are developed by people foreign to the specific context, the methodologies used must be context sensitive. An important example is participation, which may not be regarded the same in a developing country context as in a developed country. Participation needs to be approached more critically and without the assumption that it will always and necessarily bring benefits.

Technology *transfer* is used to describe the process of "transferring" ICT from one country to another. This usually means from a developed country to a developing one.

Since the social system perspective indicates that it is not meaningful to transfer just the technological artefact, the notion of technology *learning* is more suitable to describe the process of learning the technology, which includes more than just the technical aspect. A third notion is technology *translation*, denouncing any transfer at all, but instead explaining the use of technology in a new actor network as a translation of the technology.

Health Information Systems

Routine health information systems collect data used for analysis and management, contrary to clinical systems based on patient records, is the type of HIS we focus on in this thesis.

Primary Health Care (PHC) was introduced at the WHO conference in Alma-Ata in 1978, and proposes that essential health care is delivered as close to people's home or work as possible. Later work has argued that a decentralisation 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.

3 Health Information Systems Programme (HISP)

The Health Information Systems Programme (HISP) was initiated in South Africa to develop a health information system. The software tool called District Health Information System was developed and was used as the basis for the development of a health information system that focused on local health management. Its relative success in South Africa has led to the export of the software and the ideas on health management to countries like Mozambique, India, Malawi, Mongolia and now Cuba. The participation of Norwegian IS researchers in this international programme has been strong, and the HISP-participation in the bilateral collaboration with the Cuban Ministry of Public Health has been based at the University of Oslo.

We present the following sections:

3.1 - HISP history
3.2 - HISP philosophy and methods
3.3 - The global HISP network
3.4 - Summary of Health Information Systems Programme

3.1 HISP history

After the fall of apartheid in South Africa, the African National Congress (ANC) government launched the Reconstruction and Development Program. This program targeted those communities left out by the former apartheid rule, and one part of it was the development of a new national health information system. The old system was highly influenced by apartheid ideas and politics, having different programs for Europeans, Coloureds, Asians and Blacks. 60 % of the resources were used by the private sector, serving only 20 % of the population (Braa and Hedberg 2002). Several projects were initiated, and the Health Information System Program (HISP) was one of them. HISP was based at two Cape Town Universities, and received funding from the Norwegian Agency for Development Co-operation (NORAD) for a two to three year pilot project. The HISP team consisted of university staff, activists from the health sector and NGOs, and two Norwegian researchers.

The South African Reconstruction and Development Program meant a major reconstruction of the health sector, driven by the overall goal to achieve equity in health. It was strongly influenced by the Alma Ata WHO-model for health systems that we have described in section 2.3.2, meaning decentralisation of the health system and implementation of health districts. The HISP focused on developing an HIS to support the new administrative structures in the health districts, as proposed by the Strategic

Management Team on Health Information Systems in Western Cape (Braa and Hedberg 2002). The project's first pilot phase was carried out in three pilot districts in Cape Town from 1996-98, and consisted of 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 the implementation and use of such data sets

The pilot phase was a success story and in 1999, the Department of Health in South Africa adopted the strategies, processes, and software developed in the pilot districts as the national standard. The software is a free and open source product, which means that anyone is free to use and alter the software free of costs. This fact, combined with a Norwegian research interest has triggered an export of the software and ideas to many developing countries. In 2000, a HISP project was established in Mozambique, a neighbouring country to South Africa. The software was translated to Portuguese and adapted to the Mozambican context (Kaasbøll and Nhampossa 2002, Braa, Monteiro and Sahay 2003). The Eduardo Mondlane University of Maputo and the Mozambican Ministry of Health became collaborative members of a growing HISP network. The software has later been adopted by Malawi and Tanzania, and pilot projects have been initiated in India, Mongolia, Ethiopia, and now also in Cuba.

3.2 HISP philosophy and methods

Overall goals and motivation in HISP is to empower the poor and marginalised of the world, exemplified by strengthening local health services in developing countries with the help of modern computerised health information systems.

Approaches to health systems reforms and HISs in HISP are aligned with the WHO declarations and strategies for reaching the global health for all goals (ref. 2.3.2). These strategies have been further developed through an implementation in a South African context that strives to achieve equity in health. Local empowerment and local use of information have been and still are key targets for the South African Ministry of Public Health and HISP.

The software developed, DHIS, supports local use of information. Both the ability to use and analyse data disaggregated locally, and the possibility to make local elements, indicators and procedures is important in the HISP approaches. The software was developed with the following objectives (Braa and 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 the 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.

Braa and Hedberg (2002) put forward a model they call the hierarchy of standards (Figure 5. The hierarchy of standards), which illustrates how each level have their own needs for information.

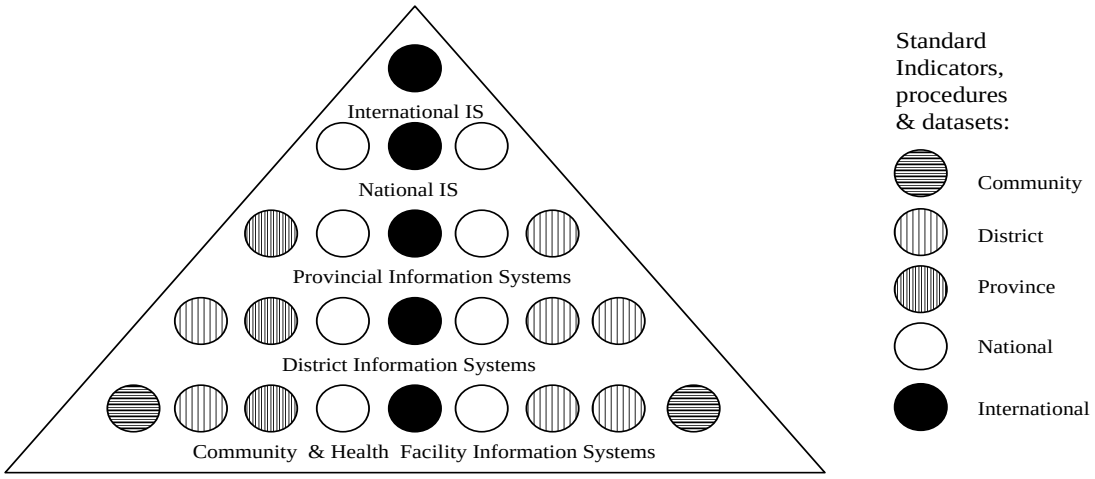

Figure 5. The hierarchy of standards

Explanation: each level has the freedom to define their own standards as long as they align with the standards above (Braa and Hedberg, 2002)

The logic behind the model is that each level in the health hierarchy is given the flexibility to define its own set of additional standards as long as it follows the standards defined by the levels above. In this way, a health district is given the freedom to implement a locally adapted variant of the provincial HIS, which again is an adapted variant of the national HIS.

Systems development and research methods supported by HISP are strongly influenced by the Norwegian researchers participating in the programme. As these methods have been central to our Cuban project as well, they are already described in the literature review (chapter 2) and in the chapter covering the research methods (chapter 4). Action research, as described in chapter 4, has been the leading research method in HISP. Systems development methods are influenced by the Scandinavian approach described in section 2.1.3, and are heavily based on participation, evolutionary prototyping and cultivation.

In the development process from South Africa the work on developing an essential dataset and the DHIS software is a good example on how these methods have been carried out in HISP projects. The nature of health information systems is complex, with many actors at different hierarchical levels and with different views and educational background, and the inclusion of health sector employees, university staff, activists from NGOs and researchers led to the implementation of the first essential dataset in the Western Cape Province in 1997. Local managers had been participating extensively in the negotiations around the dataset, and users were also encouraged to give feedback and comments on the DHIS, which first was implemented in 1998. The close collaboration between those using the DHIS and the developers resulted in rapid cycles of prototyping and improvement, sometimes creating new versions on a daily basis.

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. As in terms of globalisation and counter networks, HISP consider itself as an opposing network to capitalist driven development, being an alternative 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.

3.3 The global HISP network

The "HISP" health information does not physically exist, what exists is a South African HIS based on the DHIS software developed by HISP. This HIS consists of a database solution for local health management, working routines for information handling and use, and many processes that make up HIS. This makes it possible to "transfer" the system to other countries, and HISP projects are in fact set up in Mozambique, India, Malawi and Tanzania, based on the same approach as we used in Cuba.

The "source" of the HISP is South Africa. To describe the South African system we can use the social systems perspective described in section 2.1.1. This system was developed with methodologies on research and systems development that the HISP researchers implemented. In addition, the driving force was equity in health and empowerment of local health management as suggested in the WHO's Alma Ata declaration.

3.3.1 "Transfer" of the HISP-approach

The software (DHIS), the approaches to systems development, and the approaches to health systems reforms and HISs are all parts of an approach to develop an HIS. This is *not* a strictly defined approach, and it is best understood as a set of guidelines that are based on the previous experiences from the South African development process. These guidelines have further been elaborated as a result of new experiences from HISP projects in other countries, especially from Mozambique and India. For readability purposes we have chosen to use the term *the HISP-approach* to group this loose set of guidelines, experiences, approaches to health systems reforms, systems development and research methods etc. into one term.

An important part of the HISP-approach is to be flexible and adaptable to the context, and therefore a strictly defined approach is not suitable. The approach to develop a HIS in a new context must be adapted to the new context and not strictly copy the approach from South Africa. However, the HISP-approach can help to guide the development of a new and adapted approach that is sensitive to the new context.

When transferring the South African HIS to another country these are then the elements and processes that make up the new system:

1. The HISP-approach (as guidelines):

- Software (DHIS):
  - Translation of user interface and manuals
  - Design of database structures and datasets
- Approaches to systems development and IS research:
  - Action research
  - User participation
  - Mutual learning
  - Local focus
  - Evolutionary prototyping
  - Cultivation
- Approaches to health systems reforms and HISs :
  - WHO's decentralisation declaration
  - WHO's "the district model"
  - Action-led HIS
  - Local data for local information for local action

2. The local context:

- Infrastructure
- Human resources
- Health system organisation and politics
- Culture
- Information politics

All these elements together are part of the development process that finally produces a new HIS based on the one that is found in South Africa, guided by the HISP-approach, but developed and adapted to fit the new context.

Braa, Monteiro, and Sahay (2003) point out two main reasons for this cross-country adaptation to be possible despite the differences;

"First, the international standards on health services and procedures through the WHO make it possible to establish some basic assumptions shared by all countries about the structure of the health system (hierarchy of facilities and administrative areas), tasks and targets of the health services (they are all e.g. immunizing children), and the basic principles of data reporting and health information systems (they all collect data on e.g. immunization and other activities). Second, the IS design and development strategy is general, in the sense that, given the conditions in 1), it aims at the simple and achievable within the given context and has tools [and] technical approaches which make rapid prototyping and feedback and interaction with users at multiple levels within a larger scope possible."

(Braa, Monteiro, and Sahay 2003 p.25)

3.3.2 The HISP nodes

We will here present each of the three countries where there has been conducted the most research, South Africa, Mozambique and India.

A further examination will be done in the discussions (chapter 9) when comparing the experiences from case studies in these countries with our findings from Cuba.

South Africa

As described earlier, South Africa shifted from an apartheid regime to democracy in 1994, with a legacy of a strongly unequal health system. The processes leading to HISP started shortly after (Braa and Hedberg 2002, Braa, Monteiro and Sahay 2003)

The infrastructure in South Africa is varied, like everything else in the country. The major cities and agricultural and industrial regions are well developed while black townships resemble the shantytowns around other African cities.

The previous health information system was fragmented, with health units reporting to different health programs, NGO's etc, and the Reconstruction and Development Program created by the governing ANC proposed a district health and management information system to support the districts in local management, and to integrate the different health information programs in the district.

The HISP has its main node in Cape Town, where the University of Western Cape has been involved from the very start.

Mozambique

Mozambique was the first country outside South Africa to adopt the HISP, in 1998 (Mosse and Sahay 2001, Braa, Monteiro and Sahay 2003, Mosse and Sahay 2003). The country has suffered 20 years of civil war since the independence from Portugal in 1975, and it suffers heavily from the legacy of it. Millions of landmines still scatter the countryside many years after the war. The illiteracy level is as high as 57% (Skobba 2003). Infrastructure is generally poor, especially electricity and roads, which were further worsened during floods in 2000.

An analysis of the ICT use at district and province level in Mozambique (Braa et al 2001) shows that there are few people with skills in ICT, but that people get help and support through informal networks, such as people working with computers in education, administration etc.

While exploring the Mozambican context, Braa et al. (2001) found that the person responsible for analysing data at a health unit put figures on the wall, but could not see any relevance between the targets and the actual figures. The targets were set without using population data, and an immunisation rate of 10% according to the target was not that bad since the target was unrealistic.

India

India is the world's largest democracy of over one billion inhabitants, and received its independence from Great Britain in 1947. The two states HISP is working in are Andhra Pradesh, 92 million, and Karnataka, 52 million, both in the south part of the country. Andhra Pradesh initiated a HISP project in 2000, later followed by Karnataka.

Major problems in the two provinces are poverty, overpopulation, illiteracy and poor health services. The literacy level for the country is 55%, with a higher level for men than women. Of the age group 11-14, only 50% are enrolled in school. The infant mortality rate of Andhra Pradesh is 37 for urban areas, 70 for rural (Meland 2003).

Several case studies have been done on the HISP India project, among them Meland (2003), Larssæther (2003) and a sum up by Braa, Monteiro, and Sahay (2003). Meland (2003) reports of poor infrastructure, and especially power cuts hampered the training processes. India has very few medical doctors, a trained health worker, who is not even a doctor, serves 5-7000 people.

Malawi

Malawi is also a poor country in Sub-Saharan Africa, were a Dutch NGO funded two Malawians to attain University of Western Cape's summer school in 2001. 11.6 million people are divided into 18 districts (Braa, Monteiro and Sahay 2003), making each health district ten times more populous than in Cuba. The life expectancy is 36 years (WHO 2003b), and the country suffers heavily under the HIV/Aids epidemic.

3.4 Summary of Health Information Systems Programme

The Health Information Systems Programme, HISP, was initiated after the fall of apartheid in South Africa as one of several projects to decentralise the health system and empower those marginalised under the previous rule.

The work focused on developing an essential dataset, a process of standardisation and fierce participation with staff from several sectors, and on developing the District Health Information System, the DHIS.

As the name of the software suggests, the aim is to empower the health Districts, as advocated by the WHO as the best unit for PHC management. The principles of equity in health, district focus and local use of data and management are heavily embedded in HISP.

The goal for HISP has grown to be empowering the poor and marginalised in general, not only in South Africa, and the software and ideas have been adapted to several third world countries. The "HISP-approach" for this adaptation includes many things, not just the free software DHIS. Action research, user participation, mutual learning and understanding, a focus on local level, action-led data collection and information use are all part of the approach. This then has to be adapted to the local context, including infrastructure, human resources, health system, information politics etc.

The context of the different HISP nodes differs a lot. South Africa and India has reasonably good infrastructure, but lack medical personnel. Mozambique and Malawi are poor, as are the infrastructures. There are two main reasons why the cross-country adaptation is possible despite the differences. First, international standards on health services and procedures create some degree of similarities between them, second, the IS design and development strategy in the HISP-approach is general in the way that it aims

at the simple and achievable in the given context, and has tools and technical approaches which make rapid prototyping, feedback, and multi-level interaction with users possible.

Part 2 Methods

"I want to add something, and I do not want anyone to take it as a sign of vanity on the part of our people, because whenever I talk about what we have done for education and healthcare, we actually feel ashamed as we discover more and more new possibilities, ashamed that we did not discover them before. Let no one think that Cuba boasts of its success. There are things that even we are not aware of. "

Speech given by the Fidel Castro Ruz at the Law School of the University of Buenos Aires. Argentina, May 26, 2003

In this part we present our research methods. NBmer her blabalbala…….

Chapter 4 Methods

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4 Methods

This chapter first presents theory on relevant methods and our research approach, with a description of the different methods used, along with a discussion around possible limitations regarding them.

The following sections will be presented:

4.1 - Research methods
4.2 - Our research approach

4.1 Research methods

As we have conducted Action Research in several Case Studies, we will here present each of the two terms.

The following subsections will be presented:

4.1.1 Action Research
4.1.2 Action Research in the field of IS
4.1.3 Case studies

4.1.1 Action Research

Action Research (AR) is defined by Greenwood and Levin (1998) as

"..social research carried out by a team encompassing a professional action researcher and members of an organisation or community seeking to improve their situation. AR promotes broad participation in the research process and supports action leading to a more just or satisfying situation for the stakeholders." (Greenwood and Levin 1998 p.4)

AR is thus a process of social research where both outsiders and problem owners work together to solve a problem. The method seeks not primarily to look for generalizations or to prove theories to be true or false, but concentrates on solving real life problems while creating knowledge. Contrary to conventional social research, where it is often viewed as necessary to not interact with what you are studying to be fully objective, AR focus strongly on this interaction. The professional researchers must participate with the problem owners in the specific context to obtain insights that can not be understood when studying it "from a distance". The professional researcher can be characterised as the friendly outsider (Greenwood and Levin, 1998), who is able to loosen up tensions between the stakeholders or brake up the positions they may be stuck in. Stakeholders can have difficulties in seeing their own situation and may have lost faith in the possibilities for change. This is not in contrast to the belief in that the stakeholders know their situation best, since this still may be true even if they can be stuck in habits and are unable to see the possibilities. The professional researcher also often face groups of people who for some reason have trouble communicating with each other, and the position of a friendly outsider can help the researcher to address these problems

"Local people, because of their history together, because of local social structures and economic relations, or simply because of decorum, often are unable to tell each other uncomfortable things that they clearly are aware of. (ibid. p. 105)

The history of AR is not very long, with the first projects taking place during the Second World War. It was later further developed in Norway during the Industrial Democracy Project, and the notion of democracy stands very strong in AR. With researchers actively participating together with the stakeholders, the process itself gets more democratic with everyone able to contribute. AR researchers believe that everyone has the potential to analyse their own situation, contribute to the process, and add valuable knowledge and understanding to the others involved. The core of this principle is democracy, since the inclusion of local problem owners as co-researchers democratises the research process. The different aspects of the context and problem are well known by the stakeholders, and together with the professional researcher this can be addressed with appropriate methods. The researcher will gain knowledge from the other participants about the problem, and they will learn about ways to deal with these problems with the researcher.

The broad participation and the focus on democratizing the knowledge generating process can lead to many positive effects in the sense of learning. Actors involved get a closer relationship to the researcher, which may contribute to a more informal and open discussion, often harnessing more of the potential among the stakeholders. As mentioned earlier, social relations can be softened up, and even those not normally participating in discussions can contribute meaningfully to the community when facing researchers on equal premises. The goal is to generate as much knowledge as possible, and create possibilities.

AR can be classified of being either in the northern tradition or the southern tradition.

"The "Southern" tradition is committed to community transformation through empowering disenfranchised groups; the "Northern" tradition is concerned with reforming organisations through problem solving." (Brown 1993 p.249)

While the main goal of both traditions is democratizing the various organisations and people involved, southern AR relies more on the local knowledge and capability to analyse their own situation. The adjective southern is here used because it is mainly in poor third world countries that this strong emphasis on local democratization and empowerment of the oppressed has been the driving force, but this also applies to "southern" areas in rich industrialised countries as well, where poor and marginalised face the same problems as in Africa, Latin America and parts of Asia. The aim of the strong focus on local knowledge is to promote respect for it, and in this way open up the local people for collaborative efforts due to a better relation between them and the outside researcher.

"The fact that knowledge is local and grows out of intense personal experiences makes it respectable and encourages outsiders to listen to what it says and to try to build on what it offers. Put another way, this approach to local knowledge credits the poor and oppressed with having intelligence and analytical capabilities that are generally ignored."

(Greenwood and Levin 1998. p.177)

The relation between the researcher and the co researchers is very important to lever.

A professional researcher committed to a project in a southern context may face many problems, including bad experiences among locals with foreign intervention, which the rich western researcher can easily be identified to belong to, hostility, hiding local information, feeling of obedience to the educated outsider, lack of self confidence among the locals and power arrangements threatened by the new changes, racism etc.

The way AR is performed, with strong participation of researchers and problem owners working to solve real life problems, is often considered non scientific by researchers practising traditional methods of social science. AR processes and its findings are often described through case studies, and this involves "storytelling". AR is context specific, and creates large amount of knowledge, both at local level and for the researchers, in the process that leads to actions. To describe this, case studies are appropriate, and, as all general laws must apply to all particular cases, detailed stories of particular cases tests the validity of general laws (Greenwood and Levin 1998).

There are no restrictions to what methods can be used in AR. Both qualitative and quantitative methods of all kinds can be used, as long as it is found useful. The different contexts and situations determines what is useful in each case, but there are still three elements that must be present for a process to be AR (ibid.), namely research, participation and action. They believe that AR is one of the most powerful ways to promote new knowledge. The element of participation is important to democratise the knowledge generation process and ensure that everyone take part in putting the results at work. The diversity of experience and capacities in the local group is considered an opportunity as an enrichment of the research-action process. AR seeks to change something, not just study it, and this has to lead to action. These actions are aimed at improving the situation of the stakeholders to a more liberated, democratised state.

4.1.2 Action Research in the field of IS

The use of AR in IS studies had a much later start than using it for social studies in general, and it has become apparent that the social sciences influences IS studies to a greater extent than the other way (Greenwood and Levin 1998).

The Scandinavian approaches to IS described in section 2.1.3 follow the AR method, and the Scandinavian projects (Iron and Metal Workers Union, UTOPIA and Florence) outlined earlier are all good examples on how AR has been interpreted in the field IS. The use of AR in these Scandinavian projects has evolved through these Scandinavian projects and its development has followed the three generations (2.1.3) of Scandinavian IS approaches (Greenwood and Levin 1998).

AR has now gained acceptance at the same level as quantitative studies in the field of IS (Avison et al1999). Following The International Federation for Information Processing conference in 1998, Avison et al. pointed to five main contributions of AR in development of information systems (ibid.);

- The Multiview 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

In 2003, a special issue of the prestigious paper MIS Quarterly named "Action Research in Information Systems" manifested the shift to qualitative methods by the mainstream of researchers.

Action research projects in the field of IS meet the complex reality that the social system perspective on IS reveals. This complexity is often more severe in IS projects in developing countries, which is a typical setting for action research in the field of health information systems (HIS). A common problem originating from this complexity is the failure of the action to be *sustainable* when the researchers leave, i.e. the action does not persist over time. This is often the results in small donor funded pilot projects focusing on action on a limited scale, like only a few model health units, only one level of the health hierarchy, or just a small part of one health program out of the many that a primary health centre are responsible for (Braa, Monteiro, and Sahay 2003). Outputs from such limited action research initiatives are for all practical purposes useless for the health manager, since only full coverage will help the manager in daily management and resource allocation. When there are no benefits of such pilot projects, the efforts remain largely unsustainable (ibid.).

Thus, action research IS projects, especially in developing countries, needs to *scale up*, to spread, to achieve the critical mass of users to cover their needs. In the context of HIS in developing countries, coverage and sustainability are interconnected (ibid.), but there are also other aspects involved with sustainability. The way AR efforts are aligned with existing structures and networks, especially regarding aspects of control and institutionalization, are important for how the new IS will be used, if used at all. The amount of knowledge transfer that has taken place is also important, as local expert groups are responsible for continuing maintenance and development when the researchers leave. Networks of these groups provide more sustainable projects than 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)

Braa, Monteiro and Sahay (2003) argues that AR in IS calls for large networks to survive, exemplified by Health Information Systems in developing countries. The network of such action is considered crucial to scalability and sustainability. They argue that this can be accomplished with "networks of action", where the contemporary nature of networks, built around information and communication technology (Castells 1996), facilitates this. They draw from Elden and Chisholm's (1993) key lessons from two decades of AR within IS development, namely the need to situate the action within networks rather than on singular units.

Castells (1996) argues that groups or regions that have been historically marginalised, as primary health care in developing countries (Mosse and Sahay 2001, 2003) will be further marginalised if they are not able to participate in the "network society". Linking up to the *networks of action* above, the marginalised make up a *counter network*

opposing the "natural logic" assumed by the proponents of the "global village" (Braa, Monteiro and Sahay 2003, Castells 1996).

4.1.3 Case studies

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

(Cornford and Smithson 1996 p.49)

This exploration often needs to have a certain time span, as a snapshot of a situation at a particular moment can not capture the processes of change. The researchers devote themselves to the specific situation, the case, and the reward is a richness of data, obtained by multiple means (ibid., p.49). Following the tradition of positivist science, a single case study can be hard to use for generalisations. By finding other such studies this problem of quality can be addressed by developing stronger and stronger evidence for certain relationships. A greater number of case studies give a better base for comparative studies.

Walsham (1993, 2001) denotes case studies as "interpretive", where different researchers may have different perceptions of a study. The purpose of these different studies is to reveal "a truth" rather than "the truth", since a case study will be interpreted differently by different people, and the case will be told using the researcher's own thoughts and ideas on the phenomena described.

4.2 Our research approach

In this section we outline our choice of research approach. We also present the HISP team working within the project and the methods used to obtain data.

Following the tradition of HISP, we used AR to encounter the research work in Cuba. The very nature of adapting and implementing such a system needs lots of action, and the possibility for us to participate in that action is a great opportunity to learn. Events including participation were the development of datasets, local discussions and implementations, and training done at each pilot site. As part of the HISP team we encouraged and promoted participation among all the people involved in the process.

AR within the HISP process typically represents the southern tradition. In South Africa, however, HISP has become the national standard, and research there now focuses on both democratising and decentralising the health services, and improving the effectiveness of the national health system. This is more according to the northern tradition of AR (Braa, Monteiro and Sahay 2003). However, in the other nodes of the HISP network the southern tradition is still dominant.

The following subsections will be presented:

4.2.1 - The HISP team
4.2.2 - Interviews
4.2.3 - Training
4.2.4 - Observation
4.2.5 - Literature and schemes

4.2.6 - Sub-cases in the project
4.2.7 - Possible method-related limitations

4.2.1 The HISP team

The HISP team working in Cuba consisted of the two authors, one additional student taking over after we left, and their supervisor from Norway. The initiator and our contact was the Director of the Cuban Health Statistics (DNE), and the Cuban person responsible for HISP was his assistant. Later, small local teams were formed at some pilot sites, consisting of skilled and enthusiastic people from the local health services and the corresponding administrative unit. Towards the end of our stay the network administrator of DNE joined the two authors and supervisor for a week of field work in Sanctí Spíritus Province. He has later worked closely with Pål de Vibe, the other Norwegian master student who has continued the work in 2003. The supervisor has several years of experience from developing and implementing IS in developing countries such as South Africa, Mozambique and Mongolia, especially in the field of health services. The Director and the Cuban Project Responsible are the highest level of the health information system in Cuba, and have years of experience in developing and monitoring it. The Cuban side was responsible for the project, and the two authors would function as system experts together with the senior researcher. Our role would include adaptation and implementation, and training. We would simultaneously function as researchers, in close collaboration with the stakeholders.

We took actively part of all aspects of the project. Our work included training at all levels, defining databases, implementing and adapting the system at each pilot site. We had meetings with the parts involved at all levels, both formal meetings and informal talk. The team, usually consisting of only the authors and the local contact person, gave several advantages. Very few knew English, so fluency in Spanish by Ola Titlestad was crucial for the work outside Havana. With 14 pilot sites and limited time, there was a lot of travelling. The team could together better organise the logistics and face the whims of Cuban transport problems, or decide a plan and then split to save time and money. The Cuban HISP team has also greatly benefited us after we returned from Cuba, as we have regularly contact by e-mail with Pål de Vibe in Havana, with valuable comments from other participants in the wide HISP network. As Cuba is a node in the HISP network, the Cuban HISP team is part of a larger network of professionals in a range of related fields, as medical staff, statisticians, system engineers and students.

4.2.2 Interviews

Cornford and Smithson (1996) list some critical interview problems.

- Getting to see people
- Getting to see the right people
- Time to prepare, travel and write-up
- Keeping interviews on the topic

We had the intention to interview several people, mainly directors and administrators, both before we left for Cuba and as the project went on. But this proved hard to achieve, because it was hard for us and the subjects to find time to do so when we travelled

around in the provinces. We also experienced that we were not allowed to meet people, and that they had been told not to spend any time on us. This was the case when we tried to meet people outside the statistics branch of the health services. This is a violence of the first two criteria in the list, and after a while we abandoned the efforts to organise formal, more structured interviews.

So few formal interviews were conducted, but we had long and constructive discussions with many people at all levels. This was mainly day to day communication with people we worked with, but it also took the form as informal, semi-structured interviews were we sat down and discussed topics we wanted to have clearified, often not planned but more as a necessity at that certain time. Often our days were hectic with travels and meeting new people, and semi-structured interviews were based on improvisation. This is a natural consequence of the strong focus on participation in action research. We also had close contact with statistical and administrative people after work, as we often were invited to stay at their place or socialise with them in the evenings. We feel therefore that we had a good tone and the discussions were open and freely and provided us with a great and positive output.

4.2.3 Training

We conducted initial and later more in-depth training at every pilot site. During this action, we could mutually learn from each other, as well as develop local expertise to support sustainability. We had two major training sessions, one week in Havana and one three day session with participants from three offices in Jagüéy Grande. These sessions, together with the training given at each site when installing software or updating databases, were as vital for us to understand the use of the reporting system and how data elements were created and used as the training of computer and software use for the local staff. In this close collaboration with the stakeholders we could draw from each others experience, giving us valuable inputs from a range of professions.

4.2.4 Observation

Action research is known as an approach where the researchers forsake their traditional roles as observers of events (Cornford and Smithson 1996). But this does not mean we did not use observation as a means of getting relevant information. Much knowledge was derived observing statistical workers in action, as a preface to discussions and to get an initial understanding of routines and habits. Also, observation of workers playing with the computer, exploring software and mouse-screen interface provided us with hints on how to do training. These observations were, as with the interviews, often not planned, and the subjects observed were often unaware that we observed them. It could be that we had finished training, and sat in the next room discussing other matters, and this may have been enough for someone too shy during training to explore the computer themselves. For many who have never seen a computer before, the first step to use it in front of fellow colleagues was too long to take, and people could hide behind the other, more eager. Such observations were often useful to see to what extent people had learned from the training in the cases where not everyone had tried it on the computer. An important note here is that using the computer could be seen as a symbol of status, and that there are strong hierarchical relations in Cuba, and that this could affect the way the participants were using the computer.

4.2.5 Literature and schemes

We had access to all report schemes and forms within the statistics system of the health systems in Havana, and also when they were in use out in the provinces, municipalities and health units. We were free to study the databases, on computer in Havana and the provincial offices, paper-based elsewhere. This was extremely useful when planning and setting up the database in the software, and when selecting data-elements to include in the first essential set.

Other literature which has been used in the knowledge-creating process is local and international media, publications by the Cuban government, and internet based publications from the UN, UNDP and WHO.

4.2.6 Sub-cases in the project

When using the notion *sub-cases* we refer to each of the pilot sites, the local offices involved in the HISP project on Cuba. When using *the Cuban case*, we think of the Cuban project as a whole.

The DNE selected 11 pilot sites (see Table 2) to participate in the project. In addition, a lot of work took place in the national office in Havana, and a polyclinic which is administrated from one of the pilot sites and had a computer from an UN project were also included in the second visit of the authors to Cuba. The column "Data capturing unit" indicates whether or not the office is the place where data is first captured and entered into the information system in schemes and reports. In case of a 'no', data is aggregated from sub-offices.

Site	Data capturing unit	Urban/rural	Patient pool (total inhabitants)	Employees in the statistics	Computers before project	Distance by car from administrative unit
Havana National office	No	-	11 million	15	Yes	-
Matanzas Province	No	Mix	661 000	?	yes	2 h
Jagüéy G Municipality	No	urban	57 000	2	no	1,5 h
Jagüéy Grande Polyclinic	Yes	urban	?	5	no	-
Jagüéy Grande Hospital	Yes	urban	66 000*	2	no	-
Ciénaga Municipality	No	Rural	9000	2	no	0,5 h
Sanctí Spíritus Province	No	Mix	462 000	7	yes	5 h
Sanctí Spíritus Municipality	No	urban	80 000	2-3	no	-
Trinidad Municipality	No	Mix	50 000	2-3	no	1 h

Fomento Municipality	No	Mix	36 000	1-2	no	1 h
Fomento Polyclinic	Yes	Mix	?	6	no	-
Yaguajay Municipality	No	Mix	52 000	1-2	no	1 h
Mayajigua Polyclinic	Yes	Rural	8700	3	yes	0,5 h

Table 2. Pilot sites overview

*Explanation: * Jagüéy Grande Hospital serves both Jagüéy Grande and Ciénaga municipalities.*

4.2.7 Possible method-related limitations

Several factors may have influenced our research. As part of the HISP team we may have affected people we talked to by our presence, as foreign researchers with expensive equipment and governmental backing. This could make the different participants in the project look at each other differently. We could be regarded as officials, hence not getting the close relationship to the stakeholders that we need to get the most of the collaboration. Cultural aspects such as a strong respect, almost fear, for the hierarchy, may also have affected the way people related to us. But even if we cannot exclude that this happened, the effect of this was minimal. We never experienced that people, once we got to know them, would hold back ideas of improvement or in any way not consider themselves as our equals.

On the contrary, there is in an action research setting a bias towards positive results because of the research component. The methodology may thus prove less applicable in a real-life setting where the researchers are not present (Korpela et al. 2000)

Action research is not a quantitative method for making generalizations, and we are aware of the danger of making such generalizations based on our limited research. But through several qualitative sub-cases, and by comparing with cases from other countries, we conceptualise the general ideas. And according to Greenwood and Levin (1998); since general laws must apply to particular cases, particular cases test the validity of general laws. We have done research at 13 different sites, and at all levels of the hierarchy. All the way from the doctor who produces the data to the very top where the data is presented to the Cuban government and international organisations. We have made four different databases, to suit four different levels of data. In our case study we have several sub-case studies, namely each of the pilot sites, and in these we can see evidence of relations between them. So we feel that our experiences and impressions reflect the true Cuban health system.

4.2.8 Possible context-related limitations and misinterpretations

Written sources on Cuba are often hard to interpret. Whatever comes from Cuba, especially the government newspaper Granma (www.granma.cu), is often skewed in favour of the Cuban government. There is not a free press in Cuba. On the contrary, some news in the neighbouring country of USA tends to be influenced by the strong anti-Castro movement among Cuban exiles in Florida. Sources on ICT, the health

services, politics and economy in Cuba often mirror the political viewpoint of the author.

As an example of the different rhetoric used one can look at the same case in two newspapers, the Cuban Granma and the BBC. The story is about a book revealing the actions of a Cuban dissident, who Cuba accuses of being an opportunist just looking for as much money as possible, whoever is his employer. The overall aim for the Cuban government seems to be to destabilise the opposition and question their political aims.

news.bbc.co.uk, august 19, 2003:

"For 35 years, Elizardo Sanchez has been a public critic of Fidel Castro's government. This book, written by two Cuban Government journalists, alleges he has been leading a double life and that five years ago he was recruited by the Cuban authorities as a spy. Mr Sanchez, who spent eight and a half years in a Cuban jail in the 1980s, has dismissed the claims as complete lies. Whatever the basis of the allegations, they do confirm the Cuban Government's determination to sow suspicion amongst its opponents."

www.granma.cu/ingles, august 19, 2003:

"the book, produced by Editora Política at the Alejo Carpentier print shop, reveals gossip-laden struggles, opportunist alliances, back-stabbings and betrayals by so-called internal dissidents in order to appropriate the largest amount of the money sent from abroad by U.S. and European funders aiming to change the social system freely chosen by the Cuban people."

Also from the same article in Granma is an example of the aggressive style when describing anything from the US. The common thought in Cuban media is that almost all US policy and action is a conspiracy to overthrow the Cuban government.

"This amount includes funds from USAID - an agency that is part of the U.S. government's budget - to support organisations collaborating in that country's federal program. The monies are used for "promoting the rapid transition to democracy;" in other words subverting the island's constitutional order and bringing down its government."

From www.usaid.gov we get a different, more modest tone, even though the content is the same:

"The overarching goal of U.S. policy toward Cuba is to promote a peaceful transition to democracy on the island. To that end, policy is proceeding on a multi-faceted track: pressure on the regime for change through comprehensive economic sanctions; outreach to the Cuban people; the promotion and protection of human rights; multilateral efforts to press for democracy; and migration accords to promote safe, orderly and legal migration."

Daily life in Cuba is heavily influenced by political decisions, and Fidel Castro fiercely advocates the official view on TV almost every day. Marches, demonstrations and huge rallies are used to gather support and to give the people a feeling of common values. This influenced us too. Most of the data about Cuba we have found at reliable sources, as the UN or WHO, but in the chapters about the Cuban context we had a hard time finding any good, reliable sources. Most of it is derived from our own experiences, but then again, asking a Cuban official about Cuban public institutions will certainly not give you a negative answer, as we will comment later.

As mentioned regarding interviews we had difficulties meeting people outside the statistics branch. This severely limits the views we could get on important issues. From the very start of the project we were locked in the statistics branch of the health services, and it took a while for us to realise we were just to work with the statisticians. As described later, many important political changes took place between our first and second visit. The Cuban government became more hostile to foreign involvement, and we first had problems to get into Cuba. When there we found that our actions were severely limited. We had restrictions on travel, and we also needed permission from the highest level in the Health Statistics to see anyone outside the statistics. This led to some confrontation, after which we were further limited to offices and people we had already met and whom it was approved that we could meet.

4.3 Summary of methods

We have chosen to use Action Research (AR) for our studies in Cuba. AR is a democratic method were the researchers work in active collaboration with the problem owners to solve a problem. It includes three elements;

- Research. In our case, we want to explore the constraints for system development in developing countries.
- Participation. Local problem owners participate with the researchers. Mutual learning is the result, and a best possible solution is the goal. We participated with Cuban staff at all levels in the health statistic hierarchy.
- Action. The research must lead to something, a change of the situation for the stakeholders. We worked on developing a decentralised HIS to improve data use at local level in the Cuban health system

Since it is not a quantitative method, it was seen as inappropriate in the field of IS, but has now gained a wider acceptance and led to a number of important contributions, among them the Scandinavian research efforts in labour unions.

A major challenge for AR projects is to achieve sustainability when the researchers leave. They must persist over time. AR projects in the developing world are often donor funded, and face the problem of a limited scale and time span. When the researchers leave, the scale is often the decisive factor when it comes to sustainability. Small scale action research initiatives are much less likely to be sustainable than larger networks of action.

AR is often criticised as being storytelling, with little extracted knowledge. It is hard to make generalisations using AR, but many case studies, and sub-case studies, can be used to conceptualise general ideas. A case study is an in-depth exploration of one situation.

Under the overall AR umbrella, we have used research methods as interviews, training, observation, and studying literature and schemes. Time constraints and Cuban control limited the amount of formal interviews, so mostly were semi structured. Literature on Cuba must be approached with some suspicion, since both Cuban and US official and unofficial sources are highly biased.

Part 3 Empirical Study

"In our country, in fact, children who are born with some sort of mental disability – and this is something we are studying in depth: the causes that lead to different types of mental retardation, whether slight, moderate, severe or profound, each with its own characteristics; fortunately, the slight and moderate cases are more numerous – at this moment, we have every case recorded, and not only the children, but also the slightly more than 140,000 people with some form of mental incapacity. All children with some type of physical or mental disability, or who are blind, or deaf-mute, or something even more terrible, blind and deaf-mute at the same time, they are all registered."

Speech given by the Fidel Castro Ruz at the Law School of the University of Buenos Aires. Argentina, May 26, 2003

In this part we describe our empirical study, the Cuban HISP project. This empirical study is presented in four chapters:

5 The Cuban context

6 An overview of the of the Cuban HISP project

7 The development of a Cuban HIS

8 Potential benefits of a computerised HIS in Cuba

In these chapters we give a thorough description of the Cuban project, and we start with a description of the context. Then we outline project actions from both a global political brokering perspective and a local research and systems development perspective. This presentation of our empirical study makes up an important basis for the discussions that follow in the next Part.

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5 The Cuban Context

In section 1.3, when outlining the objectives and research objectives we pointed out that an understanding of the Cuban context is important in order to answer our main research objectives, especially how we can transfer the HISP-approach to the Cuban context. In this chapter, we will give a background of the Cuban context that will help us to understand project incidents, and provide the background needed to analyse our research objectives.

The following sections will be presented:

5.1 - Demographics
5.2 - History
5.3 - Politics
5.4 - ICT in Cuba
5.5 - The Cuban Health System
5.6 - Summary of the Cuban context

5.1 Demographics

Cuba is the largest of the Caribbean islands, and its 111,000 sq. km. makes it around 1/3 the size of Norway. 11 million people live on the island and the official estimation is that 66% are white, 12% black and 22% mulatto. In addition, another 1.5 million Cubans live in the US, of whom half live in southern Florida.

Havana is the Cuban capital with a population of 2.1 million. Cuba is divided into 14 provinces, which again is divided into 169 municipalities. The country is historically divided into two parts, *el Oriente* and the *el Occidente*, the east and the west. The western part is the most developed, with the capital Havana where the pre-revolution American influence is visible. The eastern part with Santiago de Cuba as the biggest city is poorer and less developed, and has a strong Caribbean influence.

The official language is Spanish, and only few speak English. Most of the people are descendants of immigrants from mainland Spain and the Canary Islands, or of the 800,000 slaves that were imported from West Africa during Spanish colonial rule. Some French also came to Cuba after a slave uprising in the neighbouring French colony Haiti.

The climate is subtropical, with rainy season from May to October, and hurricanes tend to hit the island in the fall and early winter.

5.2 History

Cuba started its modern history as a Spanish colony, after being discovered by Christopher Columbus in 1492. It was conquered with the establishing of seven

settlements in 1514. The Indians were soon decimated due to persecution, slaughter, or new diseases from Europe, and slaves from Africa were imported to work the land. The main industry was cattle ranching and profitable conquests of the Aztec and Incan empires on mainland America, but later sugar and tobacco became the main cash crops.

Almost 400 years passed with wars with the British, pirates and smugglers, before Cuba was granted its independence from Spain after the USA had taken the island in the Spanish-American war. What followed was an important preface to how Cuba functions today. The island was placed under US military occupation until 1902, when Cuba officially became independent, but the US intervened again in 1906 and held power for three years, and then again in 1912 and 1917 (Cuban government 2003, CIA 2003)

Corrupt leaders followed the tradition of incompetence and discrimination against blacks, while US companies bought up two thirds of Cuba's farmland. Cuba became a haven for US tourists, promoting legal drinking, gambling, and prostitution. Civil unrest in wake of the great depression were quelled with terror, and the later Fuelgencio Batista and his fellows enriched themselves as Cuban land, industry and services came to foreign hands. The ordinary Cuban drew no benefits from the way the country was governed, and faced torture and even execution if opposing it. People could "disappear" on the street, and the legal system was not functioning.

To this background Fidel Castro and 82 companions returned to Cuba after training and raising support abroad to launch a guerrilla war in 1956. Many people flocked to support them in the mountains in the south, and by mid 1958 Castro could send out his forces for Santa Clara and Havana, led by the legendary *commandantes* Ernesto 'Che' Guevara and Camilo Cienfuegos. Batista fled the country 1. January 1959, and this is celebrated as the day of the triumph of the revolution.

Through the early years of the revolution, the Cuban government shifted more and more towards socialism, and the Soviet Union. The will to redistribute the sources of production, including the huge sugar plantations owned by Americans, the telephone network, oil refineries (Texaco, Standard Oil and Shell), and banks, led to the agrarian and urban reforms of 1959 and 1960 (Svensk-Kubanska Föreningen 1983). The USA, the market for 70 % of Cuban exports, answered by cutting sugar quotas, which the Soviet Union promptly promised to buy. Thousands of people fled to the US, and CIA backed counterrevolutionary groups on the island. The first years came close to a catastrophe as professionals, managers, and technicians didn't share Castro's view, and left for a better life in the US (ibid.), a turning point in the educational policies in Cuba. We witnessed the fruits of this focus on education during the course of our research.

Whether Castro had always believed in socialism, or were pushed into close friendship with the Soviet Union due to the circumstances is still a matter of discussion, but the conflict reached its peak with the failed Bay of Pigs invasion and the Cuban missile crisis early in the sixties. Cuba became an important actor in the cold war, and Soviet technicians, arms, as well as ideas, politics, and public service structures were installed on the island. The 60's, 70's and 80's saw great advances in almost all sectors, gaining from a subsidising Soviet trade. Crops had been focused on sugar, as the favourable Soviet sugar agreement subsidised Cuba for three decades.

The strong Soviet-dependent economy, led to a subsequent disaster as the Eastern European communism collapsed in 1989. However, the inefficiency in the economy and the impact of too centrally focused governing (ibid.) had shown several years earlier, with a falling production and lack of quality. Nothing could save Cuba when its totally dominant trading partner could not pay over-market prices anymore, subsidises and aid worth US $5 billion (Press 1996). Moreover, as Eastern Europe and Russia had their hands full reorganising their governments and spend their money elsewhere, Cuba entered the Special Period, announced by Castro in august 1990.

In the last decade, Cuba has met the economic disaster with varied success, and is now facing new challenges as international tourism drops following 11 September 2001, the supply and price of oil is fluctuating, and the increasing threat of US military intervention guided by US president Bush's rouge-state rhetoric.

5.3 Politics

We must stress the fact that it is hard to find objective information on Cuba, as there is a though propaganda battle fought through anti-Castro media in the US on one side and a government-driven Cuban media on the other. Objective descriptions of the situation are hard to find, and we have tried to extract the main lines from various sources, both pro and con Cuban.

The following subsections will be presented:

5.3.1 - The political system
5.3.2 - Economy
5.3.3 - The Embargo
5.3.4 - Recent political events
5.3.5 - Foreign collaborations in Cuba
5.3.6 - Political impact on project actions

5.3.1 The political system

The only official political party is the Cuban Communist Party, even if people technically could go for election as party independent. An interesting point is that Castro himself was not a member of the Communist Party in his youth, but active in the Orthodox Party. The electoral system is based on direct democracy, in which everyone can run for a seat in the National Assembly of Peoples Power or the provincial assemblies. However, only one candidate is allowed for each seat, 601 in the National Assembly, and 1192 in the provincial assemblies, and the voting is for whether or not the candidate for each seat is approved. The municipal assemblies can have several candidates for each seat (Svensk-Kubanska Föreningen 1983).

The economical planning is centralised, according to a Soviet model, where planners in Havana set quotas of production for every sector. The strong centrally planned economy proved inefficient in the long run, and things had to change. In 1986 steps were taken to reduce bureaucracy and decentralise decision making, and later anticorruption measures to increase efficiency and stop criminal behaviour among officials, like drug trafficking.

Nevertheless, despite some reforms in 1986, the Cuban political system is still centralised. Compared to a typical western country, the Cuban system is particularly centralised and has and a heavy bureaucracy. There is a strong national uniformity, and political changes are often implemented all over the country at the same time to maintain both social and geographical equality. The capital city Havana represents a power centre, and the President and the ministries take most decisions on how things are run in the provinces. Almost every day the Cuban people can hear speeches of Fidel Castro setting the political and economical agenda. His reputation of political wisdom are, if not unquestioned, strong among most Cubans, especially those old enough to remember the pre-revolution era and the good years in the 70's. The Cuban system represents a highly hierarchical structure with strong and well-defined command lines. During a conversation the fall 2003, Bye describes the hierarchical structure in the following way:

"In all positions down the hierarchy the Cubans try to do what they think would be right according to Fidel's ideas and philosophy, clearly a difficult task since his ideas are not that well documented, and an inefficient and not very innovative system."

(Bye 2003[1])

Decision-making is centralised and most decisions are unquestionably taken at the national level, but there is an uncertainty about how many decisions that are taken by Fidel himself and not by his ministers. Our experience with the Cuban system is that only a few men can take the important decisions, and often just one man. In chapter 7 we will describe how our contact, a national director in the health system had limited power and authority, and how managers and directors at lower levels in the hierarchy seemed much more like the comply-type than the decide-type of a manager.

An interesting description of Fidel's power is one of a former vice-minister in the Ministry of Sugar who resigned after the failed "10 million tons of sugar" (Bye and Hoel 2000) project in 1970 (Central planners aimed at producing 10 million tons of sugar, and it was put enormous prestige in the project. Despite perfect weather and the record harvest of 8.5 million tons, Castro and his economical planners suffered a humiliating setback):

"It came to a point where I could not anymore be part of Fidel's unlimited power exhibition based on a total arbitrariness" (By and Hoel 2000[2] p.215)

A former department-bureaucrat gives another description:

"The worst is that the complete Cuban state-apparatus, which in practice means almost all of Cuba, is ready to put this man's ideas and plans out in action. I am far from saying that all his ideas have been wrong. However, the problem is that there is only one man who is allowed to think out new ways of problem-solving in this country, below him sit tens of thousand bureaucrats like me, in I think the most vertical hierarchies in the world, just waiting to put his more or less spontaneous ideas to action."

(Bye and Hoel 2000[2] p.216)

A concrete example of centralised power-exhibition from our project was the complete change of administration in the health department in July 2002. The health minister and most of his vice-ministers were fired for some non-logical reason, apparently to give

[1] Our free translation based on informal talks with Bye in October 2003
[2] Our translation from Norwegian to English

room for some fresh blood, and a new and younger administration took over. This episode, and how it had direct impact on our project, is described in chapter 7.

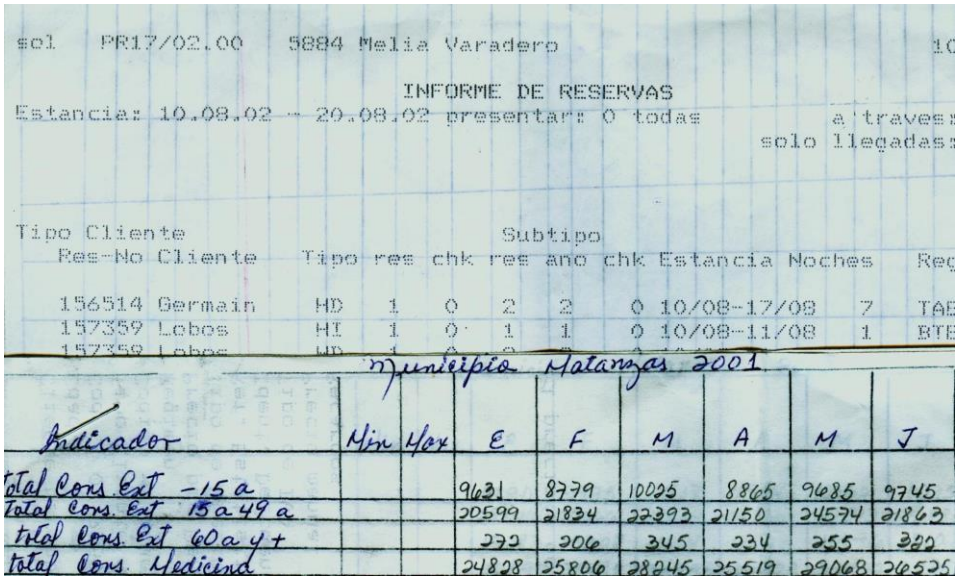
5.3.2 Economy

The Cuban economy is centrally planned, and has traditionally focused on supplying the East Bloc countries with agricultural goods and raw materials. This had to change in 1990. Here we outline the economical situation now, and how changes have been made since the end of the Soviet Union.

In the years following of the Special Period, Cuban's were allowed to possess dollars, some self-employment was legalised, and farmers markets were opened, allowing farmers to sell their surplus on the private market. This was a reaction to the black market trade in dollars and the fact that unemployment was once again coming to Cuba as the government could not afford its policy of work for all. Tourism has become a major industry, and many joint ventures have been established with foreign companies in this sector, mainly from Europe. The result, other than the emergence of class differences and prostitution once again, is e.g. the spreading of high bandwidth optical cables from Havana to other tourist areas. Tourism is an engine of growth in Cuba, and leads to better infrastructure and transport, and more goods in dollar shops and the industry serving the tourists (Brundenius 2002). The strong focus on tourism follows the Cuban tradition of playing everything on one card. With many joint ventures in the tourism industry, collaboration on a health information system is not prioritised by the central planners. We were told so simply because "we do not generate dollars".

The general decline in tourism after the September 11th incident on Manhattan and the subsequent anti-terrorism wars, have hit Cuba quite hard. Many projects of development of tourist areas have stopped, and the main income industry of hard currency has had a hard time. The hurricane Michelle in November 2001 destroyed infrastructure and a lot of Cuba's main citrus growing area. There have also been coup and strikes in Venezuela, Cuba's most important provider of oil, affecting Cuban economy hard. The lack of petroleum is affecting all transport, as Cuba's own oil is of a quality only suitable for power generation. The Cuban electric power production in mainly based on oil plants, and even with its own oil fields the power has to be rationed. Black outs are common, and transport problems huge. We often had to supply the official cars from the ministry of health which were used for our transportation, with gas and lubricating oil paid in dollars, since the ration-card stations were out of stock. For us, many working days were partly lost or in other ways disturbed due to power cuts and transport problems.

There is also lack of paper, and people are inventive in using old books or cartons several times. Figure 6 shows an inventive solution used to report monthly data to the provincial office in Matanzas, using the back-side of a paper with data from a nearby hotel. Data reporting is mostly done by paper in Cuba, and the lack of paper is quite a big problem. Along with computers and printers, we brought some paper from Norway, on request by the Cubans.



sol PR17/02.00 5884 Melia Varadero 10

INFORME DE RESERVAS

Estancia: 10.08.02 - 20.08.02 presentar: 0 todas a traves:
solo llegadas:

Tipo Cliente Res-No	Cliente	Tipo	Subtipo res	chk res	ano	chk	Estancia	Noches	Reg
156514	Germain	HD	1	0	2	2	0 10/08-17/08	7	TAE
157359	Lobos	HI	1	0	1	1	0 10/08-11/08	1	BTE
157359	Lobos	HD	1	0	2	2	0 10/08-11/08	1	BTE

Municipio Matanzas 2001

Indicador	Min	Max	E	F	M	A	M	J
Total Cons Ext -15 a			9631	8779	10025	8865	9685	9745
Total Cons. Ext 15 a 49 a			20599	21834	22393	21150	24574	21863
total cons. Ext 60 a y +			272	206	345	234	255	382
total Cons. Medicind			24828	25806	28245	25519	29068	26525

Figure 6. Back side of a reporting form

Explanation: The figure shows the back side of one of the schemes we got with data from the municipality of Matanzas. The paper it is written on is a reservation list from Mélia Varadero, a nearby hotel. The front is shown on the lower part of the figure, with data for 2001. Note that in Cuba Indicator *is used for raw data elements, creating some confusion when trying to explain what we mean with indicators, namely a product of a numerator and a denominator.*

The legalisation of dollars and some self employment, and the important farmers markets, have spurred some development in the private sector, but the GDP in 1998 was half that of 1989 (Press 1996), and the impact of the US trade embargo is substantial (Svensk-Kubanska Föreningen 1983, Press 1996, Aitsiselmi 2001). The embargo put an end to a trade which in 1959 counted for 70% of total Cuban trade.

5.3.3 The Embargo

The single most important economical and political factor in Cuba today, except their socialist system, is the US embargo. Even though its importance compared to ineffectiveness and bad centrally planning can be discussed, it sets the political agenda and have direct impact on everyday life for Cubans.

The US trade embargo, formally The Cuban Assets Control Regulations, was issued on July 8 1963 under the Trading with the Enemy Act. It was later expanded by the Cuban Democracy Act of 1992, The Helms-Burton Act (1996), and the Trade Sanctions and Export Enhancement Act (TSRA) of 2000. It applies to all American citizens and all permanent residents of the US, wherever located, all people and organisations physically in the US, and all branches and subsidiaries of US organisations throughout the world (US Dept. of the Treasury 2003).

The basic goal of the sanctions is to isolate the Cuban government economically and deprive it of U.S. dollars (ibid. p. 1)

No US products, technology, or services may be exported to Cuba, not even from a third country. Vessels carrying goods to or from Cuba need authorization to enter US ports, and vessels that have been to a Cuban port are prohibited to enter a US port for

180 days. The latest amendment, the TSRA, allowed donations, export or re-export of items such as food, medicine, medical equipment, works of art and publications. In reality, it is still hard for Cuba and American citizens to engage in such trade, as ships coming from Cuba still need authorization to enter US ports. Following the main goal stated above, no goods or services of Cuban origin may be imported to the US, effectively blocking Cuba from its main natural market. The losses in income to Cuba because of this are huge. American citizens are prohibited from travelling to Cuba; exceptions include once-a-year visiting of relatives for Cuban exiles, government officials, journalists on missions, teachers and students on special courses, athletes attending a sport event, and other forms of special visits. Most would need a license based on one of this reasons. Tourism is not allowed, and those with a license to go there are not allowed to spend more than a certain amount of money each day, currently about US $270. Although a few Americans visit Cuba via a third country (they face fines up to US $250,000 if caught), these regulations is estimated to stop millions of tourists every year going to Cuba.

The embargo has been unaccepted by an overwhelming majority in the UN for many years, and is a controversial subject in US policy as well. The US policy after the fall of the Soviet Union and the East Bloc has been to tighten the embargo in a hope that the situation would be so intolerable that it would lead to an overthrow of the Cuban government. This is not how it has evolved, and the Cuban economy, despite facing huge difficulties, continue the strong emphasis on health care and education for its people.

5.3.4 Recent political events

Over the past 2 years Cuba's position in international politics, both related to the US and to the European Union, has changed to the worse as a result of several breaches of human rights, actions that Amnesty International (2003) see as a result of an aggressive antiterrorism campaign led by the US Bush administration.

US-Cuban relations

The political discussions in Cuba now are very often about the ongoing "Batalla de ideas", the battle of ideas, with the US-driven anti-Cuba campaign at the one side and the Cuban government at the other. The problematic US-Cuban relationship has been escalating over the past five years and recently it has resulted in Cuban execution of hijackers trying to reach USA from Cuba, and aggressive military threats from the US.

Two questions of high importance and of great value for propaganda have been fought about with the US recent years. The Elian case in 1997, where a surviving raft refugee boy had to be returned from Miami to his father in Cuba, and the case about the "Miami 5", five Cubans accused of spying on the US, currently imprisoned in Miami. 2002 was dedicated the year of the Miami 5, and they have had a very high profile in the media. After a constitutional change during our period working in Cuba (which cost us 3 working days, we discuss this later), Castro proclaimed communism forever in Cuba.

With the US Bush administration the negative relationship between the two countries has been intensified. The Cuban government has felt threatened by an aggressive US anti-terror campaign and the war against Iraq. Cuba has been accused of developing

biological weapons and been mentioned by US officials in relation to the war against terrorism (Amnesty 2003). Cuba, together with Iran, North Korea, Syria, Libya and Iraq have been categorised as the Axis of Evil. This threat has led to a hardened Cuban campaign to protect the revolution, and Amnesty (2003) see the recent clampdown of dissidents as a reaction to the tough line taken against Cuba by the Bush administration. Cuban news is dominated by stories on the Cuban-US relationship, often referring to the latter as the aggressive Yankee imperialists.

EU-Cuban relations

The escalated governmental campaign against dissidents and the executions of hijackers has challenged the Cuban-EU relationship. The European Union is Cuba's leading trading and investment partner, but the EU stated that these human rights could jeopardise their relationship with Cuba (Reuters 2003).

Recent events like the arresting of dissidents, confiscating of their computers, incidents of plane and ferry hijacking heading for the US mainland, exemplify how the Cuban political environment has become more problematic. The hard foreign pressure on Cuba, also recently from the EU, and the everyday hardship for Cubans, make the political situation difficult. For now, Castro and his followers appear to have control, but perhaps at a too high cost.

Propaganda as a tool to protect the system

In this battle of ideas the majority of the Cuban people see only the Cuban government's version of the events. The Cuban media paint an extremely black ands white picture of the US-Cuban relationship and use the big ugly wolf picture of the US government for all its worth. Posters, newspapers, television, all kind of media channels give the same message, a massive propaganda campaign to glorify the political system and to stand together against the common enemy, often the aggressive imperialistic neighbour. And the Bush administrations hardened politics against Cuba just make it easier for the Cuban government to unite the Cuban people against this common enemy. Mass demonstrations and public rallies are common, often ordered from Castro himself, to unite the people and secure support for the government. We personally experienced one of these mass demonstration were 90%, of the people all over the island attained a demonstration condemning the embargo and the US aggression.

5.3.5 Foreign collaborations in Cuba

Since the revolution in 1959, Cuba has been among the most isolated countries in the world. After the fall of the East Bloc countries and the following economical crisis in Cuba, the country had to loosen up on ideological constraints and increase collaboration with western countries. We have already mentioned how the Cuban tourist industry has many joint ventures with foreign companies. Cuba is constantly struggling to balance an increased foreign involvement with the overall political goal to protect the revolution and its ideology. There have been mixed experiences with this liberated policy, and the government's attitude towards foreign collaboration projects have varied a lot over the past few years. However, the Cuban government is extremely careful in controlling foreign investment, and there is an extensive political control mechanism in place to control all actions related to foreign projects. We have been surprised by how slow

different bureaucratic instances that are involved in the process of controlling foreign collaboration projects are. Concerning projects within the ministry of health the first instance that handles practical issues like visa and working permits is the international relations office within the health ministry. This office has to report to the MINVEC, the ministry of foreign relations and economic collaborations. The MINVEC controls and monitor all foreign collaborations and take the important decisions on which projects that are approved or not. When our Cuban colleagues talked about MINVEC, it made us think of the old Soviet's Polit-bureau. As we will explain in further detail in chapter 6, as soon as our project became official the MINVEC were responsible for all our activities in Cuba. But, considering visa applications MINVEC has to report further up to the Ministry of Immigration and considering working permits the ministry of employment. As these ministries have tight budgets, prioritise tourism, and have to comply with the Cuban political scepticism, a small research project involving students is not handled first. With these bureaucratic units involved in visa application and approval of foreign involvement, the process becomes exceptionally slow and may be difficult to understand to western organisations that are used to more efficiency.

Recently, the Norwegian Chargé d'Affairs in Cuba said that foreign investment and collaborations are not very popular right now, but that this might be different next year since this attitude is varying. The current hard political attitude towards foreign involvement can be seen in light of the recent global political events mentioned above, and part of the hardened campaign by the Cuban government to protect the revolution.

5.3.6 Political impact on project actions

After looking at the political aspects of Cuba, we will here outline a few main points that had direct relevance for our research. More examples than those mentioned below will be found in our empirical chapter (Chapter 6).

Important issues of the political context relevant to our research were:

- Centralised socialistic state
- Centrally planned economy
- Focus on tourism
- The US trade embargo
- Poor infrastructure and public transport
- Lack of petroleum
- Bureaucratic control instances for foreign collaborations.
- Unpredictable political environment to foreign involvement

The first issues presented obstacles to the project work. Firstly, our research approach was not primarily developed for the restrictions we met. We wanted to do most of our research at the lower levels in the health hierarchy, where health data is collected and used, and involve these levels in action research. The Cuban side, however, sees the top levels as most important for information use.

The central planners in Havana control the workforce and all goods, and decide on what they find best for the country. As an example on how this central planning have impact

on the remotest areas we can mention that during the current petrol crisis the pilot municipality of Yaguajay is systematically subject to a central power saving strategy, and suffers from blackouts many hours a day, several days a week. We were told that other remote, non-touristy, and non-industrialised areas suffers from the same power-saving strategy. The health statistician in Yaguajay has severe problems with the use of the computer due to a central decision to save petrol by shutting down the electricity in a remote village.

The focus on tourism for generating growth helped us access internet in hotels and special communication stations, but also led to the down-prioritization of our non-dollar generating project.

The embargo deprives the overall Cuban economy, and we had problems getting reports due to lack of paper, and also with US software licenses and downloads of free software.

In addition to the mentioned centrally planned power cuts in remote areas, the petrol crisis caused us hours and days lost due to transportation problems. Often, even though it was officially prohibited, we had to buy petroleum to official cars since they did not have money or ration cards, or otherwise fix alternative transportation on the spot.

We experienced difficulties handling unrestricted by the national control units, even when we were doing fieldwork out in the provinces. The reason was the bureaucracy of the departments working with foreign collaboration. These departments were trusted to control foreign involvement, and restrictions in travelling, meeting people, etc, were imposed on us to secure control over the project and both foreign and local staff.

Lastly, the scepticism to foreign involvement in general, which can be seen in light of a harder global political climate, led to serious problems in getting access to research, as in obtaining work permits and permissions. This is related to the above point, but by this we mean that the political environment is not well developed to initiate foreign collaborations. Suspicion, pride and lack of time and money make such collaborations hard to start.

All these impacts on our project work will be described in more detail in chapters 6 and 7.

5.4 ICT in Cuba

One of our research goals was to look at the ICT situation in Cuba. Apparently, not much research is done in this field, and articles and reports tend to be out of date or influenced by political views. Here we will present the ICT situation in Cuba as we experienced it, both in Havana and in more rural communities.

The first two computers in Cuba were American and were installed in the 1950s (Mesher et al 1992). After the revolution trading with Cuba was banned for American companies, and the next computers came from France, later from the Soviet Union and other countries in the Soviet-led Council for Economic Mutual Assistance (CMEA), mainly in Eastern Europe. Cuba started a program to develop its own minicomputer in

the 70s, and about 300 of these were made (ibid.). But the main computer industry was making parts to export to the CMEA countries. Engineers were trained in East Germany and the Soviet Union, and both the University of Havana and Havana's Technical University had programs in computer science. After the fall of the Soviet Union and the CMEA there is no market for these components.

In the first phase of the project, even before we went to Cuba, we were told that computer resources were scarce in Cuba. We had to bring computers from Norway if we were to work outside Havana and the big cities. They did not have computers outside the main offices.

The following subsections will be presented:

5.4.1 - Software
5.4.2 - Hardware
5.4.3 - Internet and other networks
5.4.4 - How we got access to the internet
5.4.5 - Infomed
5.4.6 - Educational level and computer experience
5.4.7 - Policies and targets
5.4.8 - ICT and project actions

5.4.1 Software

Due to the now over 40 year old embargo, software and hardware from the US is illegal to export to Cuba. We encountered this already before the first computers were sent to Cuba, on which we had installed Microsoft Windows and Office. These were all licenses for the University of Oslo, and would continue to be so as the computers would officially still belong to this project, not Cuba, and therefore not violate the US embargo. But the End User License Agreement (EULA) from Microsoft shown under was the guideline for the university, and all software had to be deleted before the computers were shipped in February 2002.

Extract from Microsoft EULA:

"You specifically agree not to export or re-export any of the Restricted Components (i) to any country to which the U.S. has embargoed or restricted the export of goods or services, which currently include, but are not necessarily limited to Cuba, Iran, Iraq, Libya, North Korea, Sudan and Syria, or to any national of any such country, wherever located, who intends to transmit or transport the Restricted Components back to such country." (Microsoft 2002)

Despite this software-embargo, Microsoft software is common in Cuba. We could easily get Microsoft Office in Spanish or English, but not through official computer vendors. The free Unix-based operation systems, applications or other free and open source software was very limited, despite its huge potential to an embargoed country. At this moment, Microsoft is not allowed to receive any money at all from Cuba, but there are talks about buying Cuban Microsoft software licenses through a third part.

In chapters 6 and 7, where we go in more detail on project actions, we will give more examples on how the US embargo applies to IT in Cuba.

5.4.2 Hardware

Computers are not widely available in Cuba. It's too expensive for most people, but a few have received them from relatives in the US. Most computers are used in the public sector, and in schools. The wider spread of computers to private persons was totally stopped when the sale of computers were put under control by the Ministry of Internal Commerce in spring 2002. No computers could be bought unless they were totally indispensable. The reason for this was officially that they had to see that just those in urgent need of one could use one of the few computers they had. The blame was put on the embargo, but the decree states that all devices of mass distribution are prohibited to Cuban citizens (Wired News 2002)

The US embargo has more effect on hardware than on software. The computer industry of today is so large, however, that this does not affect the possibilities to obtain computers, printers and other hardware. Equipment from Japan and other East Asian countries are relatively freely available, if you have the dollars and the permission. But spare parts can be hard to find, and the stores has a limited supply due to a low demand from the public. In our case, we brought laptops to work on, and donated computers from Norway to use in the pilot sites. While we did not have problems to the extent of needing new parts on the donated computers, a Hewlett Packard adaptor or one that would fit our laptop, proved impossible to find in Havana, a city of over 2 million inhabitants. We went to 5-6 places, both the biggest shops for private persons and suppliers of the government, but none had any large supplies and the prices were high.

5.4.3 Internet and other networks

Internet is not used by many. According to government figures for march 2001, 60.000 Cubans had e-mail accounts, and only one third of these could send messages internationally (Kalathil and Boas 2001). There are several obstacles to overcome if you want to get on the net. First, there are physical obstacles; you need a computer and a decent telephone line. This can be hard enough. Then there is the economic aspect of paying a years income for one month of connectivity. The Cuban government sits on all the internet gateways, and charges are high to milk the tourism industry further. And if you are considered to be anti-revolutionary, you may not be approved to get on the net. Most of those who use the net are students and those working for the government. Many youth clubs around the country have internet services for local youth. It is also possible to use internet at hotels or in special telephone and internet boxes, but the price is high and out of reach for most Cubans.

If Cuba could be counted as an industrialised country in some ways, it definitively has infrastructure and network capabilities of a developing country.

The Empresa de Telecomunicasiones de Cuba, SA (ETECSA) is the Cuban state division of telecommunications. They own and maintain the telephone lines and cables on the entire island. It was previously solely in Cuban hands, but the Mexican telecommunication company Domos bought a large part of it in the early 90's (Press 1996). But due to US reactions, they sold out, and ETECSA is now partly owned by an Italian company. The main lines are old telephone lines, but there are optical cables in Havana and Isla de la Juventud. They are modernizing the net though, but prioritise tourist destinations like Trinidad and Varadero to produce hard currency. It is estimated

that around 40% of the Cuban telephone system was installed in the 1930's and 40's (Haines 1995), and the mix of later equipment (from France, the US, Canada, Scandinavia, East Germany and Hungary) makes modernizing and maintenance difficult. Cuba is frequently hit by hurricanes in the summer and fall, and the capability to repair the lines is a victim of the economic situation. We experienced problems setting up modems we had brought from Norway. Of the 12 modems we brought, for use on standard telephone lines, only two of them would function with the local net. This, we were told, was because the lines were digital, and not analogous like in the rest of the pilot sites. This is somewhat unclear still, as the modems should not work on what we in Europe would call digital lines. We experienced that where the old so called analogous lines were used, the tones on the telephones were unfamiliar to us. As mentioned above, the mix of equipment and the age and state of repair of this equipment may also contribute to the difficulty of making the modems work.

It looks like the main catalyst for spreading adequate lines and equipment is the tourist industry. Not only internet cafes and hotels are connecting, but the availability of Automatic Teller Machines (ATM) would greatly help tourists, as well as increase the amount of money the tourists spend. Not long ago there were not many ATMs in Cuba, but this has improved. In Havana it's now not that difficult to find one, and you don't need to wait in a long queue to use it at one of the largest hotels. Hopefully, the spreading of ATMs and other tourist-oriented services will bring better cables and switches to other parts of the country as well, as more and more tourist tend to explore more of the island than just the traditionally tourist destinations and resorts. Cuba is connected to the outside world with lines of various ages and capabilities. Among these are a Russian satellite and some AT&T lines to the US.

The net for cellular phones is not very developed in Cuba. The number of cell phones in Cuba is very limited, and prices for telephones and net services are high, even compared to Norway. This is not surprising, as the industrialised countries have come far in building the necessary infrastructure and the technology that makes a critical mass of users to make it cheaper. We brought our own cell phones to Cuba, and it was cheaper for us to use our net provider in Norway instead of changing to the local providers, even if all calls had to go through Norway. Only Havana and the area around the famous beach Varadero with all its hotels (includes "our" pilot city Matanzas) had a functioning net. The net is GSM and functions well with European cell phones.

ETECSA run small stations with 4-5 telephones and often a computer connected to the internet via a 56 k modem, which are manned from early morning until 11 pm. Here everyone can use the internet, but you need a card giving you a password, costing 15 dollars, and are charged an additional 5 cent fee per minute. The code on the card is only valid for a total of 5 hours use, and then you have to pay again. So in reality, most Cubans don't have internet access here. It's just too expensive, with the average Cuban income of about 12 dollars a month.

Many hotels offer internet services for both guests and non guests, but the prices are high, typically around 5 dollars per hour. And the kind of hotels that have internet, mainly in Havana or resorts in strictly controlled tourist areas, don't allow Cubans to enter. It could be understandable to keep unwanted persons, who obviously are prostitutes or hustlers of any kind, away from the hotel guests. But as an example we were stopped at a gate control before the causeway out to some coral keys, where

massive tourist development took place, and told that our Cuban partner, working together with us for two weeks, was not allowed to enter the keys because he was Cuban. The politics is to segregate the tourist from local Cubans (and the Cubans from foreigners) by offering all inclusive resorts in non-Cuban populated beach areas. The apartheid policy of Cuba is, however, not the scope of this thesis.

So Cubans with access to the Internet have it mostly through their school, youth club or working place. As all schools now have computers, some of them also have connection to the Internet. In the school we stayed when working in Havana there was a computer room with 5-6 computers connected, not only to the Cuban health net, but the Internet with full access to international mail-servers etc. The computer centres for youth have been set up to raise computer knowledge and experience among youth, and have been built in the hundreds (Associated press 2001). A few have computers at home, but not connected to any net. For those working in the health sector, most are limited to the Cuban intranet, and can only visit Cuban pages as the health base Infomed, or services from Cubasí, the official net of ETECSA. Some reports of underground access, using office passwords at home computers or buying black market access have been heard of.

5.4.4 How we got access to the internet

We had to use internet to communicate home, and, more importantly for the project, to get help on technical issues from South Africa and Oslo. A lot of constraints are removed when communicating on e-mail, and the possibility to answer regardless of time and space is particularly helpful for communicating when travelling. However, it was just in Havana we could freely use the internet from the office of DNE. But even here, the password to the proxy server was changed, and people in the office, at the national level, lost the rights to use internet for a period. The reason for this was not clear for us, but we were told that someone had misused it. In Matanzas city and Trinidad we could also use the local Cuban net, with mail service at Cubasí. This service, however, was not always stable, and a higher percentage than expected of our mails never reached their destination. In addition, the account disappeared during summer, even if it was in regular use. After completing our field work in December 2002, the account was closed for several weeks in February due to database maintenance. In Matanzas we could also use the internet on a school, but the computers were few and the school closed early. One of the persons we worked with there expressed that his highest wish was to have internet at home. In the other places we went to the internet, and therefore effective use of the HISP network, was a bit harder to access. In Jagüéy Grande the only place we could go to check our mail was the fruit juice factory just outside town. They even had access beyond the Cuban intranet, but the line was slow. In Sanctí Spíritus and Trinidad we could use the boxes from ETECSA. In Yaguajay there was supposed to be a “computer centre” with access to the net. We did not have time to explore this further. In the remaining places in the project, Ciénaga de Zapata, Fomento and Mayajigua, there was no access to any net. In Ciénaga de Zapata, even telephone lines were unstable, and even though we did get response in one occasion on the modem, the connection only lasted about 20 seconds, only enough time to download a header with the current speed.

5.4.5 Infomed

Figure 7. The Infomed website

The figure shows the Infomed opening page at www.sld.cu, and is functioning as an all purpose start page for Cubans. It includes weather forecast and general news further down. The page is also used to celebrate the infant mortality rate of 2002 (6.5%), and promoting political issues (the Miami5 and US aggression)

The medical portal "Infomed" has been a project of the Cuban ministry of health and has received funding from the US and United Nations Development Programme (UNDP). It was initiated in 1992 and offers medical news, databases (including US cancer database), forums and mail for its users. Infomed is available for medical staff where there is a computer, but internet use is in most cases limited to this site. To get out from Cuba, on the internet, you need a password to a proxy server. We found that not even the provincial offices of health had access to these proxies. Infomed has been a great success in Cuba, and offers online information in a country where paper is scarce. This aspect is not to be underestimated, as we experienced that paper could be almost impossible to obtain in large quantities, and books and sheets of paper were used several times. Infomed was awarded a gold medal under the category Health in the Stockholm Challenge 2002 for "providing effective inputs to improved health information at a low cost". Infomed has much potential still, and the spreading of computers is essential to reach the large amount of medical staff still unable to contribute and benefit from the site.

5.4.6 Educational level and computer experience

The education system in Cuba is one of the best in Latin America and is offering free education up to university level for anyone. Computer courses are taught at universities, and especially *Instituto Superior Politecnico Jose Antonio Echeverria* (ISPJAE) in Havana offers high level courses. This high supply of university graduates could be the key for a lucrative software business in Cuba. Several scenarios could be possible in the future. First, the low wage level and high competence could be a catalyst for outsourcing software projects from more expensive countries, like what is the case in India. It is just one hour away from the US, should the embargo be lifted soon. Second, it would be possible to "sell employees" to foreign companies. Cubans employed by foreign hotels etc. today get regular Cuban wage from the state, which takes dollars from the foreign firm. This could be a reality for computer graduates too. Thirdly, it could be possible that by producing a range of Cuban software some of them would generate hard currency outside Cuba (Mesher et al 1992).

But except young students at school and those employed by the state in important positions, few Cubans have any experience with computers. Among those participating in the project, there is less computer experience than one would expect from the general level of education. The reason for this is the small number of computers in Cuba in general, and especially down at the level of polyclinics and hospitals. Computers are generally found in important governmental offices, schools, hotels and car rental agencies. We found some computer experience in our pilot sites, especially in Havana and the provincial offices. Other than that, we were lucky if someone had used a computer before. One had a computer at home, sent from relatives in Miami, and a few more had experience from a UN initiated project. The skills were mainly in running Microsoft applications like Word and Excel, or locally developed reporting systems. At the national office of health statistics, where we worked when we were in Havana, there was two persons responsible for maintaining the local net and machines at the office. Other people we met, both through the project and other friends, had little or no experience with computers. A friend asked us if we could teach him some basic computer skills, a valuable asset when applying for jobs.

If Cuba wants to develop software for export, they need qualified staff in all phases of development. The only Cuban made software we found were electronic reporting schemes for the health offices at provincial and national level. There is a special organ for software development in the health services, called *Centro Para el Desarollo Informatico de Salud Publica* (CEDISAP), or Centre for Development of Informatics for Public Health. The group was formed in 1988 to cater for the "*rapid development of technology and the inevitable decentralisation of information processing"* (CEDISAP 2003), and should have some experience not just in programming, but also in system engineering. However, the design of the systems we found was very poor, exemplified by one reporting scheme which did not automatically calculate totals, e.g. when data elements are entered for different age groups. This had to be entered manually, even though it was as simple an operation as adding the value of three fields together in the fourth! The political setting also influences the way system design is done. While user participation and participatory design has grown in importance in the rest of the world, this is in conflict with the strong centralisation in Cuba. When discussed with central Cuban participants, this approach was totally unknown and not in the interest of the Cuban developers. Information systems are developed centrally in Havana, and then

spread out to the rest of the country. The overall knowledge about system development was also lower than the general education level would imply. One explanation could be that when the rest of the world entered a period of rapid advance in computers in the 90's, Cuba struggled to survive the fall of their allies.

5.4.7 Policies and targets

The Cuban government has seen the importance of educating their children in computers. For example, a project which involved the electrification of remote mountain schools with solar power, computerised 1944 rural schools in the province of Pinar del Rio in 2001. Many of these schools had only one pupil, but it was important for the government to include everyone, to "become more just" (Granma International 2001). All Cuban schoolchildren now had access to computers. But while schools all around the country could celebrate their really unique situation, other sectors were neglected. Only provincial offices and the national office of health have any computers for their statistics department. In most of the 169 municipal offices and in numerous polyclinics and hospitals, the national health program is reported with pen, paper and calculators.

The *Ministerio de la Informatica y las Comunicaciones*, the Ministry of Informatics and Communications is responsible for developing the ICT-sector in Cuba. Their mission is to "stimulate, facilitate, and promote massive use of services and products of information, communication, electronic, and automating technology to satisfy the expectations of all the spheres of society" (Cuban Government 2003).
Among its many and extensive goals for the period 2001-03, are;

- strengthening of the physical national net of telecommunication,
- improve the network services
- a sustainable and accelerated growth of software-export
- obtain highest level of security of information nets

This also reflects the overall strategy of the Cuban government, to make their economy less independent on sugar. Tourism and health services brings foreign currency to Cuba, and a healthy software-export would give the economy another foot to stand on.

5.4.8 ICT and project actions

We sum up some main characteristics of ICT that were important for our research here. The main characteristics were:

- Old physical telecommunication net
- State control of internet
- Embargo on software and hardware
- Little computer experience
- Less knowledge of system development

The old telecommunication nets of various standards are a problem for modem based reporting. Sometimes even the telephone could be unstable. For ordinary Cubans access

to the internet is closed. You need a password to a proxy server, or, for Cubans, a lot of dollars to use the internet at hotels or special internet stations in the big cities. We had to use ad hoc solutions to get on the internet to communicate with developers and researchers in other countries. ETECSA stations, hotels, and a fruit factory were the solutions to the problem of access.

As mentioned regarding economical aspects of the embargo, this also directly affected our research. Both software and hardware is affected, and this included the Microsoft licences we planned to bring from Norway. Other examples are mentioned in section **6.3.3**.

The computer illiteracy is high among adults, the focus has been on educating the next generation. If we were told that people at one office knew computers, it was often very basic and applied to few people. Much time was spent teaching basics, as mouse-screen coordination, double clicking and desktop orientation.

With little experience and knowledge of theory in system developments, the Cuban contribution to this was minimal. And political issues made our theories of user participation less comprehensible.

5.5 The Cuban Health System

Cuba is world famous for its magnificent achievements in the health sector, especially considering its limited resources. Health has a special position in Cuba, and is a very political issue (Bye 2003[3]). Today's health system is build from scratch after Castro took over, and is proudly presented as a glorifying example of how successful the revolution is.

The following subsections will be presented:

5.5.1 - Background and situation report
5.5.2 - Political and economical context for the health services
5.5.3 - Resources and education
5.5.4 - The Cuban health structure
5.5.5 - The health statistics department
5.5.6 - The health information systems
5.5.7 - The information flow and working routines
5.5.8 - Information use

A more detailed description of the Cuban health structure and the health statistics branch is given in chapter 7 where we describe our specific context for systems development.

5.5.1 Background and situation report

The health system of today is based on changes made after 1959 (Séror 2003), when Batista fled and Castro and his followers overtook the country in what has become

[3] Of translation of informal talks with Bye, October 2003

known as the Cuban revolution. Before this revolution, the health system was only for a few, although it was one of the most advanced in Latin America. Most of the people had no access to the private services, and the public health services were poorly developed. Just 15 % of the doctors were employed by the state, but the revolution changed this. One of the main goals of the revolution was to offer free health care for everyone. The new system focused on education and health services, but some problems hampered a fast improvement. Half of the 6000 doctors in Cuba fled the country, and the low educational level slowed down the training of new medical staff. But the focus was not without results, and Cuba has later remarked itself as one of the best countries in the world regarding health services. This has led to top class infant mortality rate and life expectancy and the eradication of many illnesses. Although yellow fever was eliminated as early as 1901, the various pre-revolutionary governments did little to keep up the work. After the revolution however, Cuba have got rid of polio (1963), malaria (1968), diphtheria (1971), measles and mumps (1997) and leprosy (1998) (Cuban Government 2003, Stanley 2000). Other diseases which have been eradicated include cholera, bubonic plague and rubella. Cuba has a strong biotechnical research environment, and holds 400 patents in this field (Aitsiselmi 2001). Cuba is also taking the treat of HIV seriously. Everyone infected is given treatment and education at special sanatoriums, while receiving full salary, where they are free to stay after the initial period. Cuba also has an AIDS vaccine under development. The main death causes in Cuba are heart disease, stroke and cancer, as in a developed country. As the Cubans say, “We live like the poor, but die like the rich”.

The World Health Chart (Figure 8), developed by WHO and Karolinska Institute in Stockholm, Sweden, shows Cuba as an atypical country. The chart looks at the relationship between GDP and child mortality rate. Cuba is on the middle part of GDP (note that the scale is logarithmic both on the x and y axis), but on the upper part regarding child mortality rate.

Cuba is also renowned for its export of medical staff, an aid overshadowing many of the greater and richer states of the world. Cuban doctors have done service all over Africa and Latin America, and students from the same countries have studied medicine and health care for free at the many schools and clinics all over Cuba. Cuba also produces vaccines and medicines inexpensively, giving poor countries an alternative to buying from large western corporations.

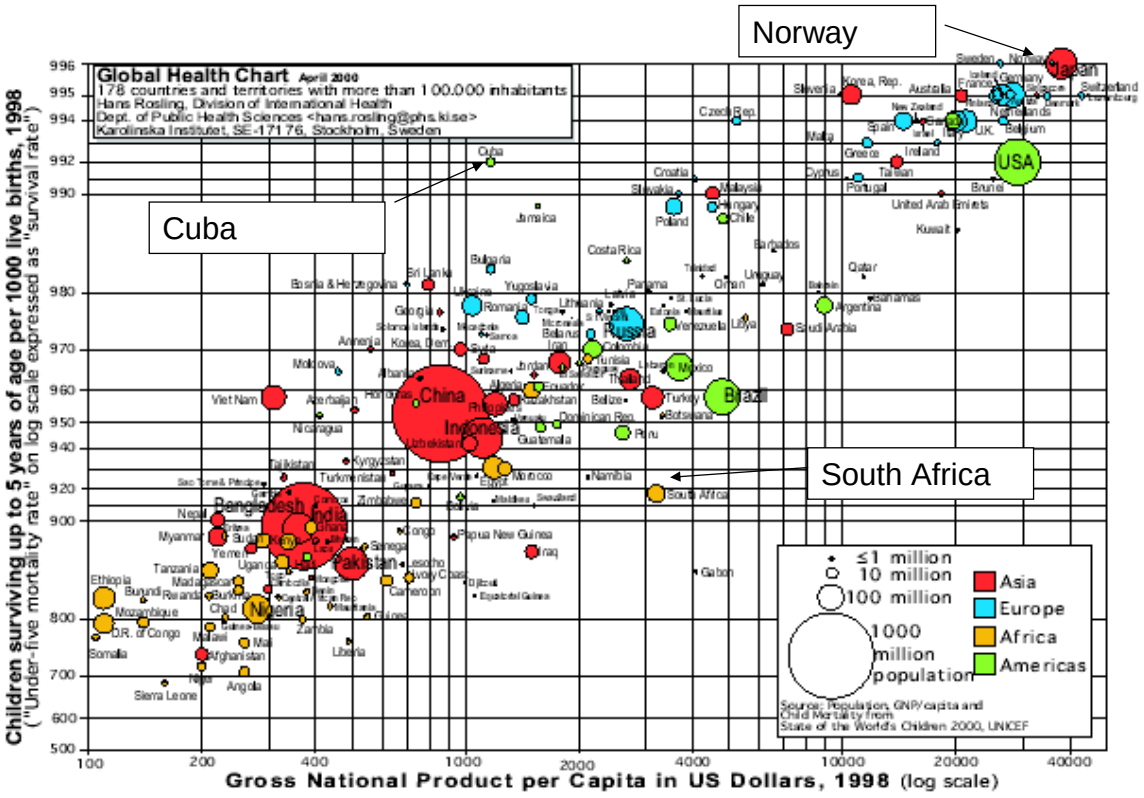


Figure 8. The World Health Chart

(Karolinska Institutet 2002)

5.5.2 Political and economical context for the health services

The actions of the first years of the revolution would change the course of the Cuban health system as Cuba entered the cold war as an important card of the two world powers' game. Soviet models were used in forming the Cuban health system, with a strong focus on statistics as a means of controlling mortality and morbidity, efficiency and progress. The embargo put forth by the USA and forced upon other Latin American countries as well made Cuba an island far away from any possible trading partners, and as the Soviet Union collapsed in 1990, Cuba had no steady supply of equipment and medicines. The embargo, called blockade by the Cubans, put Cuban economy to its knees a couple of years later.

Cuba is the country in all the Americas with the highest percentage of health expenditure covered by taxes and social security contribution, close to 90 % (WHO 2003b). There are no private health institutions, but some clinics offer medical treatment and surgery to tourists for dollars. The wage level in Cuba is very low, with a typical doctor earning less than 15 dollars a month, but petrol, equipment and medicines which can not be produced locally are bought on the international market.

The US embargo is the only embargo in recent history which includes medicine, contrary to e.g. Iraq and North Korea. So not only is the income potential drastically reduced for Cuba in general, but it is also a problem for Cuba to get access to medicines and medical equipment, at least at an affordable price. Much is bought from Europe or Asia, with a higher transport cost than if it would be bought from American countries. Cuba often has to pay extra shipping costs to cover for transport not allowed to enter US ports for 180 days (Aitsiselmi 2001). Since the embargo applies to branches and partners of the US in other countries as well, smaller pharmaceutical companies in Europe which have bought by US companies are under the legal conditions of the embargo too. Many countries, especially in Latin America face economic reactions from the US if found trading with Cuba.

The pressure on the health system has also increased in recent years, due to an aging population, increasing numbers of doctors (who all have guaranteed jobs when graduating) and surgical procedures.

However, the strong medical research environment in Cuba provides economical benefits too, such as export of many vaccines and medicines. Some of them are:

- WHO certified anti-meningitis B and hepatitis B vaccines
- Vaccines against rabies, small pox, tetanus, diphtheria and salmonella tiphi
- Monoclonal antibody and interferon, for treatment of cancer

In addition, Cuba invests in a growing health tourism, focusing on comparably wealthy customers from Europe and North America seeking treatment that are far more expensive in their own countries.

5.5.3 Resources and education

The hard and long focus on health and education in Cuba has made it a country well equipped with health physicians. The number of physicians per 100 000 inhabitant was the world's third highest, at 530 in 1997 (WHO 2003b). This is only slightly less than Italy and Monaco, and much more than e.g. Spain (424), Norway (413) and USA (279). The figures for some other countries in the HISP network clearly show how well off Cuba is with medical personnel; India has 48 and South Africa has 56 physicians per 100 000, while the figure for Mozambique is not available (WHO 2003b). The figures for nurses and dentists are not so overwhelming, but far better than countries in a comparable economic situation. The medical students undertake 6 years of education, and the graduates are required to take two years of service in the countryside on the many rural hospitals which have been created after the revolution. Many also take international assignments, like in South Africa, Angola, Mozambique and Latin American countries, and therefore have experiences from different contexts, cultures and situations. All in all this ensures a strong and experienced workforce within the health system. The number of graduates has increased steadily from 1959, and was between 4 and 5 thousand each year during the nineties (DNE 2000). However, this figure has fallen to under 2000 in the recent years. One of Cuba's problems is that a taxi driver or a "private guide" for tourists in Havana earns many times more than physicians with several years at the university.

Cuba's 11 million inhabitants have access to 270 hospitals, both rural and urban, 440 polyclinics, 258 homes for pregnant and 162 dental clinics, offering a total of 6.5 beds per 1000 inhabitant. The hospitals and clinics accounted for an average of 9.6 consultancies per person in 2000 (ibid.)

The economic situation the last decade has limited the investment in new equipment and many clinics and hospitals desperately need more resources. At latest report this is being addressed by the central government, and one can hope that this will have the effect that is needed.

5.5.4 The Cuban health structure

Below is an overview of the hierarchical structure of the health system including the leading political authorities at each level as well as the health administrations and health units.

Nivel Nacional (National level)

- Asamblea Nacional (National Assembly), Consejo de Estado (State Council) y Consejo de Ministros (Council of Ministers)
- Ministerio de Salud Pública (Nivel Central), (MINSAP, Ministry of Public Health)
- Unidades Nacionales (National units)

Nivel Provincial (Provincial level)

- Asamblea Provincial del Poder Popular (Provincial Assembly of People's power)
- Dirección Provincial de Salud (Provincial Health office)
- Unidades Provinciales (Provincial units)

Nivel Municipal (Municipal level)

- Asamblea Municipal del Poder Popular (Municipal Assembly of People's Power)
- Consejo Popular (District council)
- Dirección Municipal de Salud (Municipal Health office)
- Unidades Municipales (Municipal units)
- Area de Salud (Health area)
- Grupo Básico de Trabajo (Working group)
- Médico de la Familia (Family doctor office)

Figure 9 gives an overview of the health administrational levels and health units:

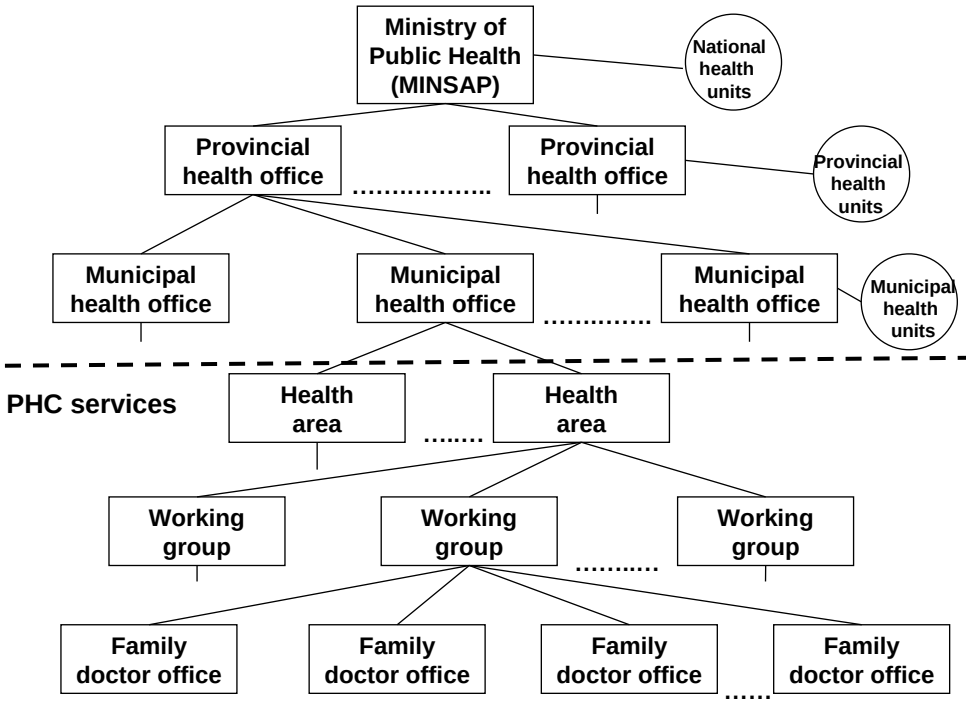


Figure 9. The health hierarchy with administrative levels and units

Explanation: In practice a polyclinic unit is responsible for PHC-services in each health area.

The following we give a description of each of the levels in the Cuban health system.

MINSAP, the national level

The central level is the Ministerio de Salud Pública (MINSAP) which means the Ministry of Public Health, and it is located in Havana. All health services in Cuba are public so this organisation encompasses all Cuban health activities and administrations.

We have copied an overview of the MINSAP's functional structure from the MINSAP's own webpage, and it shows how complex the health administration is with 6 vice-ministers and 22 national directors sorted under the health minister:

Ministro (Minister)
Consejo de Dirección (Direction council)
Consejo Técnico Asesor (Technical guidance council)
6 Viceministros * (Vice-ministers)

22 Direcciones Nacionales (National Directors) of the following areas:
Registros Médicos y Estadísticas Sanitarias (Health statistics)
Auditoria (Auditing)
Asesoría Jurídica (Juridical guidance)
Cuadros (Switchboards)
Ambulatorio(Ambulatory)
Hospitales (Hospitals)
Materno Infantil (Infant mortality)
Especialidades (Specialities)
Enfermería (Nursery)
Asistencia Social (Social guidance)
Estomatología (Dentistry)

Epidemiología (Epidemiology) Farmacia (Pharmacy) Docencia (Education) Investigación y Desarrollo (Investigation and development) Economía y Planificación (Economy and planning) Contabilidad y Finanzas (Accounting) Trabajo (Employment) Inversiones y Mantenimiento (Investment and maintenance) Servicios Básicos (Basic services) Relaciones Internacionales (International relations) Medicina Natural y Tradicional (Natural and traditional medicine) 1 Viceministro Primero y 1 a Cargo de la Ciudad de la Habana (One Primary vice-minister and one vice-minister in charge of the Havana City Province)

Table 3. The MINSAP's organisational overview

The 22 national directors are heads of their own hierarchical structures that exists in parallel to the main administrative hierarchy as seen in Figure 9. Therefore, the overall Cuban health system is a complex and fragmented system with many parallel vertical hierarchical structures, each of them with an independent line of command.

We have worked within just one of these lines of command, the department of health statistics (the DNE), and our main Cuban contact has been the national director of the DNE. The DNE director told us that there are coordination meetings with the health minister, the 6 vice-ministers and the 22 national directors at least three times a week. While we were working at the DNE, the DNE director attended such meetings Monday, Wednesday and Friday at approx. 9-11 pm, this was part of the new routines of the new minister.

There are some national health units administered from the national level. These are typical national hospitals or clinics, serving in a wider range of specialties, and special clinics like those specializing in treating tourists and offering surgery or dental care for hard currency to foreigners in Havana.

The province

Cuba is divided into 14 provinces, and the average provincial population is about 600 000 people. In addition, the special municipality of Isla de Juventud (Isle of Youth) is administered directly from the national level, making it something in between a municipality and a province. The provinces are administered from *Direcciones Provinciales de Salud Pública*, provincial health offices, which are sorted under the provincial assembly of People's Power. The provincial health director coordinates all health work in the province and the provincial health offices consist of many different smaller offices that belong to the different branches of the health system. We have worked in the statistics office, which report directly to their leading authority, the DNE, the national statistics office in Havana. The provincial health office administers the provincial health units like the provincial hospitals, dental clinics etc.

The municipality

The *Municipality* (municipality) is the next level, and the number of municipalities in each province varies around 6-15, depending of the size of the province. The *Direcciones Municipales de Salud Pública*, the municipal health offices are responsible for public health within the municipalities, and they are sorted under the municipal assembly of the Peoples Power. The municipality is the equivalent of the term district, as advocated as the best operational unit for administering and offering primary health care by the WHO. The municipality administers several health units like municipal hospitals, rural hospitals, dental clinics, home for pregnant women, home for elderly people etc. All these units report to the municipal health office.

The health area/polyclinic

The responsibility for primary health care services in a municipality is divided into geographical areas called *Area de Salud*, health area. A health area has a polyclinic that provides PHC to the population in the area. Some rural health may be served by a rural hospital instead of a polyclinic. A polyclinic is run by a director and vice-directors, and has offices for the health departments that affect PHC, like the health statistics office. Speciality consultations are done at the polyclinic facility, but basic PHC services are given at family doctor offices (CMF).

Working groups and family doctor offices

The lowest level of PHC services is the *Consultorio Médico de Familia*, a basic primary health care unit called family doctor office that serves a given population, often a neighbourhood. Every family doctor office has a doctor, called a family doctor, and one or two nurses. They are serving a population of 500-1000 people which is among the best doctor/population coverage found in the world.

The family doctor offices are grouped by a *Grupo Básico de Trabajo*, a working group, which consists of minimum 20 family doctor offices, sometimes more than 30, and has a group of specialists doctors that are shared by the offices in that group. A working group has monthly strategic meetings were the health situation of their population is discussed. A health area can have about 1-8 working groups and each group in the health area reports to the local polyclinic.

5.5.5 The health statistics department

Cuba has a large health statistics department within the health system that is responsible for all health information. If we look at the amount of health data that is collected and the number of health statisticians active in the Cuban system, this health statistics department is one of the largest in the world. Cuba has a well-defined information system for data collection and reporting. As we have seen from the Cuban health structure, the statistics department is an independent hierarchical structure (see Figure 10) in parallel to the main health hierarchy with health statistics offices at every level from the national level in Havana to polyclinics and health units at the bottom of the hierarchy.

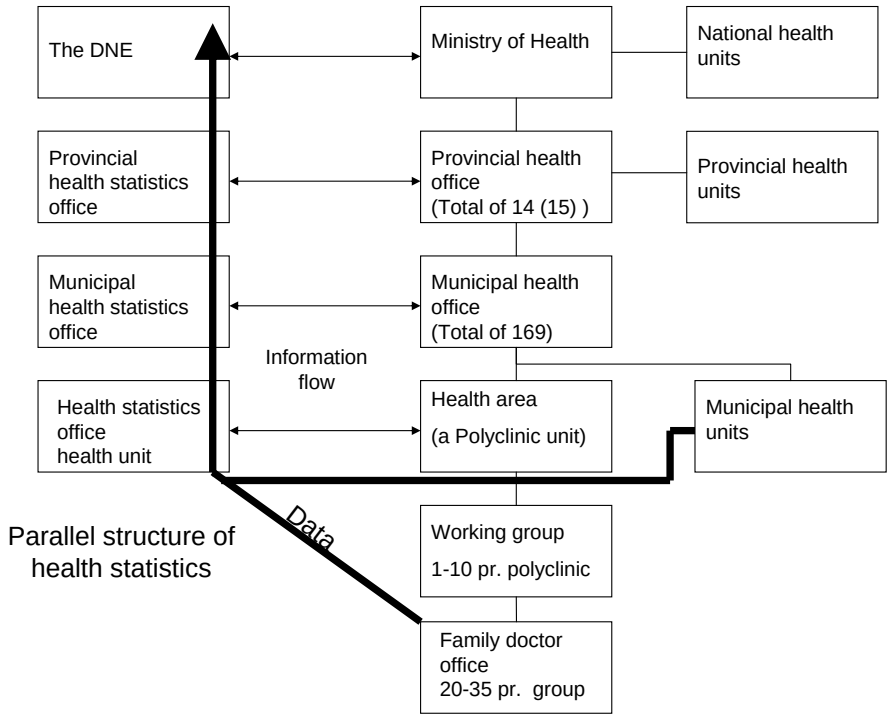


Figure 10. Parallel structures of health statistic and the main health hierarchy

Explanation: The chart shows the hierarchy of the health system and the parallel statistics offices with a dominant vertical and upwards information flow.

In the following we describe the statistics office found at each level in the health system.

The National Office of Health Statistics, the DNE

Dirección Nacional de Estadísticas, the DNE, is the National Office of Statistics within the MINSAP. The DNE is led by one of the 22 national directors that are sorted under the health minister. This national office defines all health information systems and controls that data is reported at the right frequency. There are about 20 employees at the DNE and their main responsibility is to receive and consolidate data reported from the provincial offices and national units. The DNE reports to the health minister at a daily basis, and its big overall task is to present a health statistical yearbook with the most important health statistics.

All employees at the DNE are equipped with computers and are familiar with applications like Word and Excel. The computers are organised in an internal network administered by two network administrators. The network administrators also support the staff in any problem related to hardware or software.

After working in this office for about a month, our impression is that this is a very busy place with much activity.

Provincial health statistics offices

The provincial health statistics office is found at the provincial health office. The office is subordinated the DNE and is led by a provincial health statistics director that is subordinated the national director of health statistics. These offices have a staff of about 10 statisticians, and their main task is to receive data from the municipalities, consolidate provincial totals and report to the national level.

All provincial health statistics offices are equipped with computers, and in most provinces this is the lowest level within the health statistics branch that is computerised and that has the possibility to report electronically. The provincial statisticians have basic computer knowledge in using applications like Word and Excel. There are one or more persons responsible for ICT at the provincial health offices, supporting also the computer users at the statistics department. The equipment in these offices are variable, in one provincial health statistics office we have seen old x486 computers running the operating system DOS, and another had Windows 2000 running on Pentium2 computers.

Municipal health statistics offices

The municipal health statistics office is situated at the municipal health office and is subordinated the provincial health statistics office. These offices are small and run by two health statisticians. They receive health data from all units in the municipality, including PHC data from the polyclinics. The statisticians calculate municipal totals that they report to the provincial health statistics office.

These offices are seldom equipped with computers and the statisticians use pen and paper to process the data, there are in fact offices that not even have a calculator. Some of the statisticians working here have attended courses in basic computer use, but the majority are not computer-literate.

Polyclinic health statistics offices

The health statistics offices at the polyclinics are quite big and normally have five health statisticians that process PHC data. This is where PHC data is collected and doctor's journals and patient records is organised and aggregated as defined by the DNE. Higher levels in the statistics department mostly just summarize subtotals from their hierarchical children and report the total to the level above. At the polyclinic however, there is a daily collection and processing of PHC data from the family doctors in the local health area.

The statisticians here use pen and paper to process the data as just a few percent of all the polyclinics have computers.

Hospital health statistics offices

The hospitals also have their own statistics offices. In the municipal hospital where we have worked there are three health statisticians working with collection, processing and reporting of hospital data. These offices are subordinated the statistics health office at the appropriate level. A municipal hospital reports to the municipal health statistics

office, a provincial hospital to the provincial office and the national hospitals to the DNE at the national level.

In addition, other health units like e.g. dental clinics, elderly homes and institutions for physically impaired, have their own statistics offices with similar responsibilities for data reporting as the hospitals, but we have not worked in any of these offices.

Statistics offices at municipal units seldom have access to computers, but at higher levels and at priority units in the capital there are computers. As an example the main national hospital in Cuba, the *Hermanos Ameijeira* hospital in Havana is computerised with modern equipment and has staff well skilled in the use of computers and more advanced computerised information systems.

5.5.6 The health information systems

The DNE has developed an extensive national health information system for health data. This paper-based system consists of 67 different forms covering all kind of health data. Each form, or subsystem as they call it, is on a tabular form and on 1-3 pages. A subsystem can hold from 200-4000 data entries (text boxes to fill in numbers) and the total number of entries in the complete health information system is among the highest in the world. Some forms are used at all units at all levels while others are more unit-specific. E.g. routine health data is reported on a monthly frequency from the health units to the municipal health statistics office and on a quarterly frequency to the provincial and the national level. The different subsystems have different reporting frequencies, and the frequencies can be yearly, by semester, quarterly, monthly, weekly and even daily. The DNE has gathered all template forms in a big book called SIEC (*Sistema de Información Estadística Complementario*, En. complementary statistical information system), which also contains objectives, information flow and instructions for every subsystem.

In Appendix A, in **Figure 47** and **Figure 48** the two-page form that makes up the *Consultas Externas* subsystem is presented. This is one of most widely used subsystems and it covers for all kinds of consultations. There are six pages of instructions to this form (see Appendix A, **Table 12**), including objectives, information flow, explanations for many of the entries as well as a part on revision and calculation logics. These instructions for revision and calculation logic are helping the statisticians in their work of manually validating the data.

5.5.7 The information flow and working routines

The Cuban health information system is developed at the DNE to facilitate reporting from the health units and all the way up the hierarchy to the DNE. The main information flow within the health system is vertical and directed upwards. The overall task of the health statisticians at every level is to make sure that the required data is reported at the required frequency to the level above. From a health statistics office at the polyclinic, at the municipal health office, or at the provincial health office the dominant information flow is going vertically upwards to the next level and not horizontally to the neighbouring offices and local health management. As an example

on the general information flow, we can look at how the *Consultas Externas* subsystem is reported and used in the health system (see Figure 11).

The lowest level providing PHC services are the **family doctor offices**. After every consultation the doctor adds consultation info to the *Hoja de Cargo* (en. "Load record"), a daily sheet containing patient name, type of consultation, and a diagnosis. At the end of the day, this sheet is reported to the statistics office at the local polyclinic where the family doctor office is subordinated (see Figure 12).

The next day the statisticians at **the polyclinic** examine the latest *Hoja de Cargo* sheets and extracts useful data. This data is registered in a sheet called *Diario-Mensual*, a daily-monthly sheet were all information from the corresponding family doctor office is recorded on a daily basis. It is a tabular sheet with days of month as rows and data elements as columns. The bottom row gives the monthly total for each data element for that family doctor office. All data needed for the *Consultas Externas* form is recorded in this daily-monthly sheet, as is most other PHC data as well. As mentioned, there are five statisticians working in the polyclinic, and a common way of distributing work is that each statistician is responsible for registering data from about 15-30 family doctor offices, and one is responsible for all internal data from specialist consultations done at the polyclinic. At the end of the month, the statisticians calculate the total figures for the polyclinic, the sum of all the family doctor offices and the internal data, for the latest month. Then they can fill out the forms that demand monthly reporting, as e.g. the *Consultas Externas* form and report it to the municipal health statistics office. This reporting is done by paper and most of the polyclinics actually do not have originals of this form due to lack of paper. They use the flipside of some old report or whatever paper available (ref. Figure 6, in section 5.3.2). This report is then delivered in person to the municipal office that is nearby.

At the **municipal health office**, the statistics office receives monthly reports on *Consultas Externas* from all health units that carry out consultations. Their job regarding the *Consultas Externas* subsystem is to calculate the totals for the municipality and every three months calculate the quarterly totals and fill out a *Consultas Externas* form with these numbers. This form is reported quarterly to the provincial health office. These reports are most of the time originals, and they are sent to the provincial capital by car or other means of transportation.

At the **provincial health office,** the statistics office receives the *Consultas Externas* form from every municipality in the province on a quarterly basis. Their job is then to calculate the totals for the whole province and fill out a new *Consultas Externas* form with these numbers. These data are registered in Excel sheets like the one seen in figures **Figure 47** and **Figure 48** in Appendix B, and e-mailed to the DNE as soon as possible on a quarterly basis.

At **the DNE** in Havana, there is a statistician responsible for the *Consultas Externas* subsystem and this person receives quarterly provincial totals from all provinces, and registers these data. The national level uses both a national total and the provincial totals in analysis, and the DNE presents these data for the Health Minister as part of briefings on routine health data. The main intention of these data is to support monitoring at the top level and to end up in the statistics yearbook that the DNE produce.

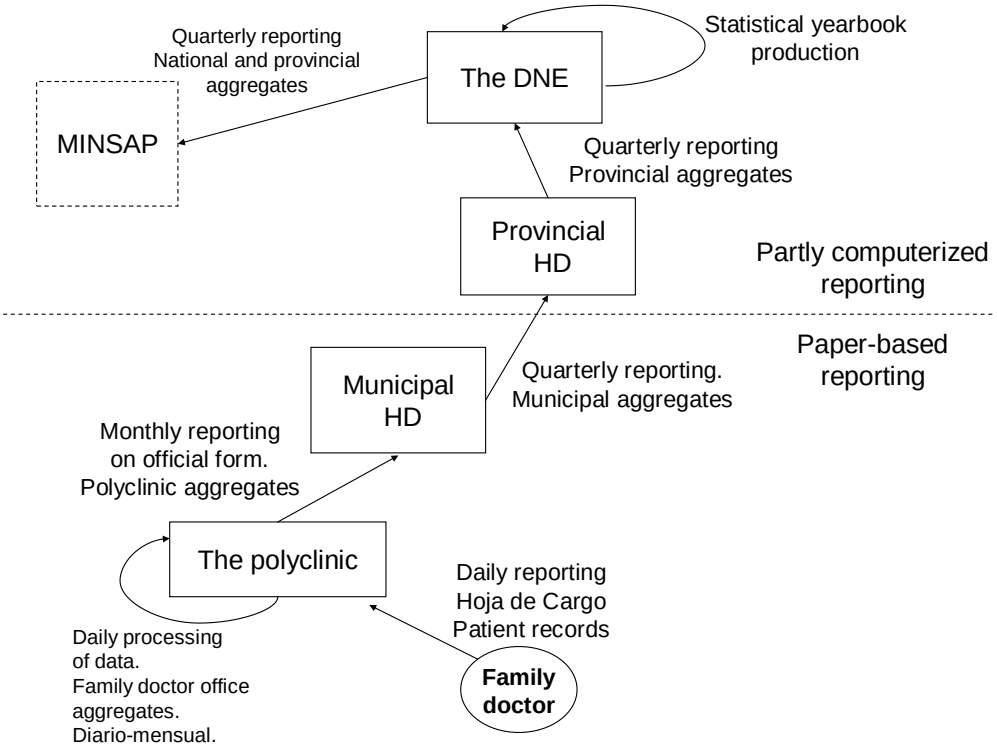


Figure 11. General information flow of the Consultas Externas subsystem

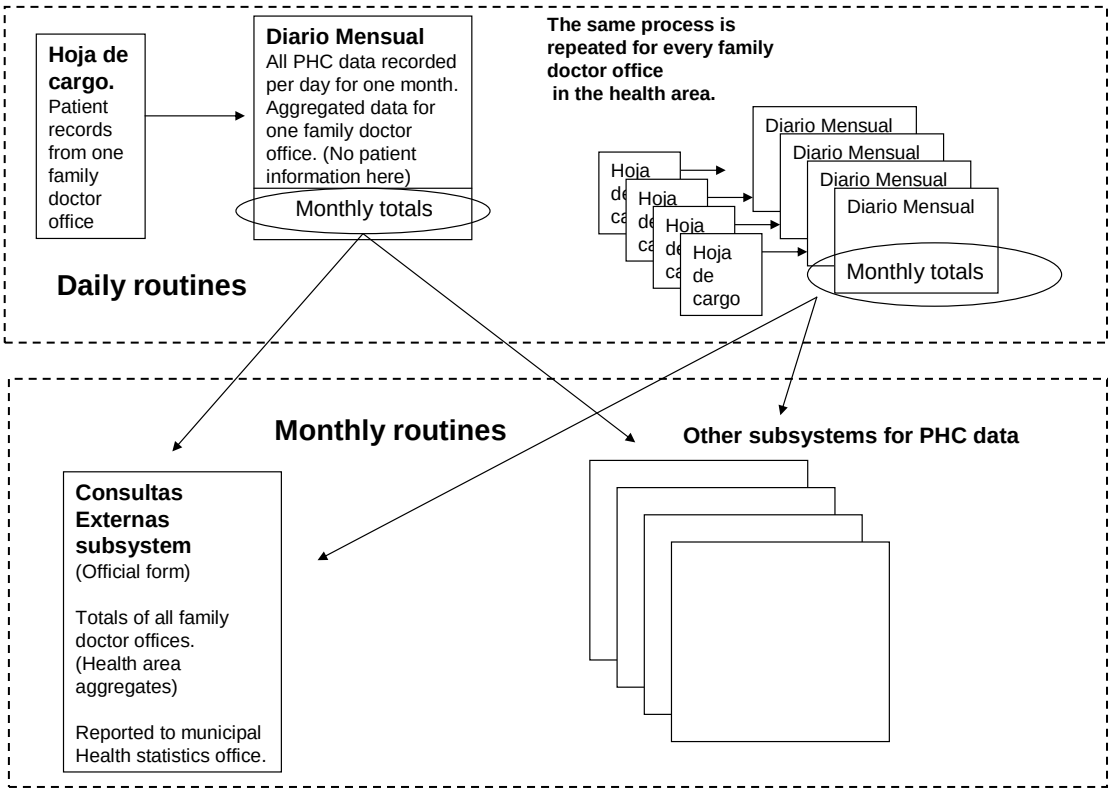


Figure 12. Working routines at the polyclinic

5.5.8 Information use

The health system's organisational structure is decentralised, in the way that the health services are offered at an extremely low level and the municipal governments administer local health units. However, the information use is not that decentralised as the structure implies. The information system is designed at the national level and its main purpose is to support a monitoring from the top level. This follows the soviet tradition of a strong centrally oriented administration and a planned economy (ref. 5.3.2). At the DNE at the national level, we have been told that people down in the system, including local health directors do not have the knowledge or power to define locally important data.

During our fieldwork in the provinces, we have seen some examples of local use of information at the polyclinics. The statisticians there told us that they have to fill out some forms requested by the local polyclinic director and the chief of the working groups. These forms are small selections of the total amount of data that is reported in the national information system, as well as locally defined indicators. These unofficial forms are results of local initiatives to get access to, and to use local data. We are not sure if these kinds of forms exist everywhere, but we have seen them in the polyclinics where we have worked.

Based on our experiences in the field we can say that there exists some use of data locally, especially at the polyclinics, but that the national health information system does not encourage these local initiatives. The purpose of the national HIS is to support centralised control and strict reporting upwards, not to facilitate local use of information. The well-defined national information system does not support the needs of the local managers to get hold of useful information, and as a result we have seen ad-hoc solutions on reports, and initiatives locally that are outside the national definitions.

Considering the well-functioning routines for data collection and reporting and the number of statisticians involved in the process, there is a huge potential in gathering and using more locally useful and action-led data at the lower levels in the Cuban health system.

Another important issue to notice is that the large amount of data in the Cuban HIS requires a high level of aggregation to be able to maintain such a paper-based system. At national level, they only have provincial aggregates and at the provincial level, they only have municipal aggregates. Local information is lost in this aggregation process which makes tracking down problems to the local level difficult (ref. section 2.3.3).

5.6 Summary of the Cuban context

The special Cuban context offer great opportunities for a well functioning health information database management, but also some challenges. In Table 4 below, we have summarised the aspects of the Cuban context that have been relevant for our project work.

Context	Characteristics	Leads to	Influenced the research
Political system	Centralised socialistic structure	Centralization of power and decision making	Needed approval from highest level to meet people at local level. Our research approach and development philosophy was political incorrect.
	Strongly patriotic and history-focused	Sceptical to foreign involvement. Need control	Troubles obtaining work permit, bureaucratic struggle.
	Health and education emphasised	Well educated staff, political will to improve health services	Well organised health system. Good practical support from relatively rich local health administrations
Economy	Centrally planned	Havana decides what to produce, and controls the whole workforce.	Power shut down every night in one pilot site.
	US trade embargo, few "friends"	Bad economy and lack of goods	Lack of paper. Had to make data-sets that would fit on one page. Petrol and lubricating oil for cars hard to get. We lost some time and spend some money on this
	Focus on tourism	New technology in tourist areas Dollar generating projects prioritised	Access to internet at hotels and special communication-stations Slow processing of plans and visa/permits for the Norwegian researchers
Infrastructure	Telephone lines old No soviet maintenance last decade	Bad lines, old standards Parts from various countries.	Our modems from Norway did not work everywhere.
	Little money for maintenance	Net vulnerable to natural hazards	Unable to communicate via internet due to flood
	Electric power scarce	Black outs, both caused by weather and by decision to save electricity	Substantial amount of time lost, 2 computers dead in first year.
	Unstable political environment to foreign involvement	Administration sacked in the health department	Struggle to get visa and work permits, project got lower priority.
Information technology use	Embargo on software and hardware	Pirate copies of all US-based software. University in Oslo had no licenses for the project	Could not do installing in Norway. Hard to get updates, patches and freeware from the net.
	Focus on computerizing schools	Well educated youth, but little computers for health services	Computer illiteracy at local level. No computers in statistics system below province
	Internet closed for ordinary Cubans	No internet at municipal level	We used a somewhat unreliable Cuban mail server for communication with Norway and South Africa. Some mails were lost.

Table 4. Summary of the Cuban context and the relevance for the project work

Health system attribute	Related aspects
Priority of the Government	Good human resources Eradication of many infectious deseases Top class infant mortality rate Focus on internationally medical aid.
Fragmented	Many vertical departments within the health sector
Family doctor system	Extremely decentralised health services, 500-800 people per doctor. Costly system
Information system centralised	Little information use at local level Huge HIS with many thousand elements HIS supports central level in control and surveillance

Table 5. Summary of the Cuban Health System

Examples and discussions on how these attributes influenced our research are presented in chapters 7 and 9.

6 An overview of the Cuban HISP project

In this chapter we will give an overview of the Cuban HISP project, *el Proyecto HISP* as the Cubans say. We start by presenting the official objectives of the project as they are stated in the *terms of reference paper* (Appendix D). The main objectives are;
1) Develop of a database system to strengthen the national health information system at all levels focusing on local analysis and local use of information, and 2) provide sufficient learning process at all levels to facilitate a sustainable Cuban system.

Then we give a chronological summary of the main actions in the Cuban HISP project from the first contact in the autumn of 2001 up until the latest developments in October 2003. The project had a promising start with a broad political support in the Cuban Ministry of Public Health (the MINSAP), but political changes soon made it a more complicated political process. Anyway, we have participated in an interesting research and development process with development and implementation at all levels in the health system.

By collaborating with Cuba we have been through a process of political brokering where we have struggled to get access to research and to obtain official contracts. Later in this chapter, we will describe this political struggle to facilitate for research, systems development and learning.

The following sections will be presented:

6.1 - Objectives
6.2 - The Cuban HISP project: A short summary of actions
6.3 - Political brokering at a global level

6.1 Objectives

In Havana in June 2002 during the first meetings between the two collaborating parts, the Cuban health statistics department and the Norwegian HISP team, the following objectives were developed (see Appendix D, the terms of reference paper):
(English translation of the terms of reference paper by the authors)

Main objectives:

- Support the strengthening and further development of the Cuban national health information system, prioritising analysis and local use of data.
- Develop a strong Latin- American node in the HISP network in Cuba, and make Cuba the origin of the Spanish version of the DHIS software.

Specific objectives:

- Identify the main faults of the most important health services, using indicators and a essential minimum dataset to register, report and inform all levels of the health system; national, provincial, municipal, health areas, and health units.
- Strengthen validation, analysis and use of information to support health management in decision-making.
- Develop a database system based on the DHIS software that supports all levels of the health system.
- Develop the human resources and the institutional capacities within the area of health information systems, information and communication technologies (ICTs), and in database administration to support maintenance of a national database system. A process that will involve national as well as international participation.

These objectives call for a systems development and learning process involving all levels in the health system. The need to support all levels, both focusing on the needs of the central as well as the local levels is a challenging task, and this trade-off situation has been subject to much discussion between the two collaborating parts. In chapter 0, we will describe the development and learning process in more detail, and see how we planned, designed and implemented a system based on these objectives.

6.2 The Cuban HISP project: A short summary of actions

In this section we will give a chronological description on the actions that have taken place in the Cuban HISP project from the initial contact in October 2001 to the latest developments in October 2003, just before the submission of this paper. Figure 13 illustrates the most important actions during this two year period. We have not been directly involved all this time, but from February 2002 to December 2002, we were active with project planning in Norway or working in Cuba. From February 2003 to July 2003, another Norwegian student, Pål de Vibe, has been working in Cuba, and during this period we have had close contact with him and been updated on project progress.

The following subsections will be presented:

6.2.1 - First contact between Cuba and the University of Oslo
6.2.2 - First round of fieldwork, June-July 2002
6.2.3 - Political changes in the MINSAP, July 2002
6.2.4 - Second round of fieldwork, Sept.-Dec. 2002
6.2.5 - Latest developments, Jan.-Oct. 2003

6.2.1 First contact between Cuba and the University of Oslo

In October 2001, Cuban delegates visited Norway in search of possible collaboration projects and they were presented to the HISP program at the University of Oslo. They

found the program very interesting, and soon a future collaboration between *Ministerio de Salud Pública* (MINSAP), which is the Cuban Ministry of Public Health, and the University of Oslo was planned. In March 2002, the director of *Dirección Nacional de Estadísticas* (DNE), the National Department for Health Statistics within the MINSAP visited Norway and attended a seminar about the HISP initiative. During this visit a collaboration paper was developed by a senior researcher and HISP responsible at the University of Oslo, and the Cuban DNE director.

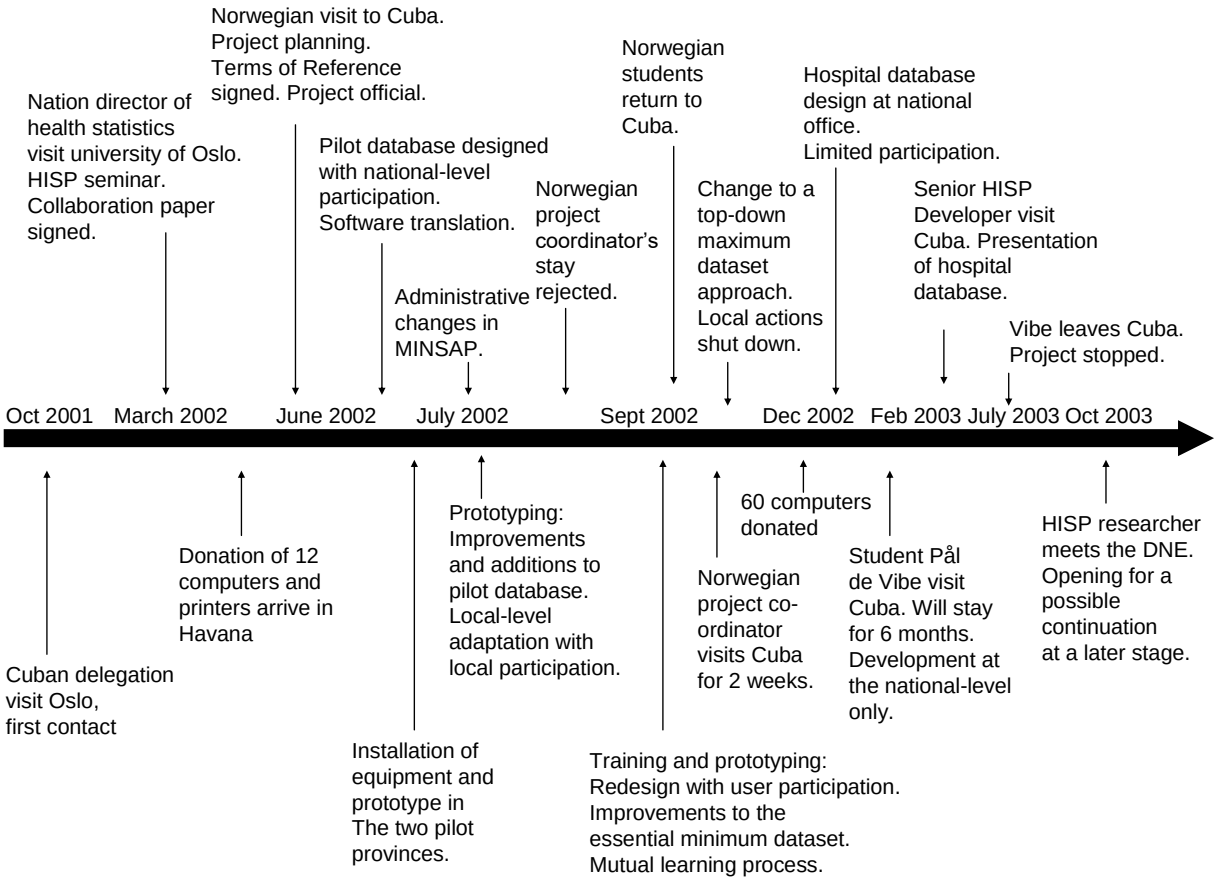


Figure 13. A chronology of important project actions

In June 2002, the senior researcher from Oslo and the two authors went to Cuba to start the Cuban HISP project. The Cuban institution involved in the project is the National Department for Health Statistics (DNE). A Norwegian donation of 11 computers in May 2002 made it possible to realise the project, and in December 2002 another 60 computers was donated to scale up the development process.

6.2.2 First round of fieldwork, June-July 2002

The Cuban HISP project was made an official Cuban collaboration project when the Norwegian senior researcher signed a *terms of reference* paper (see Appendix D) with the DNE, the MINSAP, and the *Ministerio para la Inversión Extranjera y la Colaboración Económica* (the MINVEC), which is the Department for Foreign Investment and Economic Collaboration. Based on this official paper a development

approach was developed, an approach we have called the provincial approach (7.2). The main decisions of this approach was to use an essential minimum dataset, a low level of aggregation and a mix of paper and computerised reporting to achieve better provincial coverage given the limited resources.

Then we visited health offices in the two appointed pilot provinces, Matanzas and Sanctí Spíritus, to gain knowledge about information flow and working routines at the different levels in the Cuban health hierarchy. Later, based on these local visits as well as several discussions with the DNE staff at the national level, we designed a database system to use as a prototype in the pilot sites following the provincial approach. Two provincial statistics health offices, six municipal offices, two polyclinics and a municipal hospital were selected as pilot sites within the two provinces. An essential minimum dataset of 35 routine health data elements was developed as part of this first pilot database.

After preparing a functioning prototype at the national level, and finishing the software translation process, the two authors travelled to all the pilot sites to set up the donated hardware, adapt and implement the prototype system and start with basic training sessions. However, at this first fieldtrip, limited time made it impossible to give the local statisticians more than just a brief introduction to the database system. After gaining a better understanding of the local processes through a mutual learning process, we made some local adaptations to the prototype to improve the use of the database system at each level, and to improve the data coverage within the province (see 7.4.2).

When we returned to Norway at the end of June 2002 the Cuban HISP project was official and plans were made to continue the project with Norwegian collaboration for a period of minimum one and a half years.

6.2.3 Political changes in the MINSAP, July 2002

In June 2002, we planned with the DNE that the two authors would return in September to work in the project for three months, focusing on implementation of the system in the two provinces. It was also planned that the senior researcher would return in November and work in Cuba for 3-4 months as project coordinator. However, during July 2002 there was a drastic political change in the MINSAP, and the Health Minister and most of his vice-ministers were sacked and replaced. We have heard that this radical change process and similar incidents from other ministries were reactions to the politically tense situation in Cuba due to U.S. threats on the Cuban government (ref. 5.3.4).

New visions and strategies on how to improve the health system were developed in the new administration, and part of this new strategy was to reduce foreign investments and collaborations. The new minister wanted to shut down the project, but the DNE managed to keep it alive. Still, this political change affected the way forward for the HISP project, with new restrictions on the extension on pilot sites, restricted involvement of the Norwegian project coordinator, and a general lack of priority concerning the project. Intensive discussions by e-mail between the two collaboration sides in August 2002, led to the Cuban decision to allow the two authors to stay for the three months as planned, but the Norwegian project coordinator was not allowed more than “short visits”.

6.2.4 Second round of fieldwork, Sept.-Dec. 2002

The second visit to Cuba was our main contribution to the project, and for three months from September to December in 2002, we continued the development process adapting, improving and implementing the database system. The actions taken in this period can roughly be divided into three phases; 1) training and planning at the national level, 2) a local level design and implementation process in the two provinces, and 3) a centralised development process at the national level.

Training and planning at the national level, Sept. 2002

The first two weeks of the fieldtrip we worked in the DNE office in Havana. With the national director and the Cuban project responsible we planned how to go forward with the implementation process in the two provinces. The final plan was to spend the two first weeks in Havana to train some of the DNE staff in the software, then, spend two months in the provinces, and finally the last two weeks return to the DNE again to continue the training process there and to evaluate the stay.

The national director wanted us to give the DNE staff training sessions in Excel and Access in addition to the health software. With the exception of the network responsible, the DNE staff consists of statisticians that in average have no further knowledge in computer science than basic skills in Word and Excel. Due to this lack of general knowledge of computer science, we found it difficult to train them in database theories and Access features.

At this stage we had not yet collected any Cuban data into the prototype database system, and had only an empty database designed for the Cuban health system. Therefore, we had to use South African data when demonstrating the features of the software. This complicated the training since all data descriptions were in English, a language only a few of the staff understood. We managed to show them the basics of the software, but without Cuban data the training sessions were not as fruitful as we had hoped for. We had argued that such training should be done at a later stage when we had Cuban data in the database, but the national director insisted that his staff were to be introduced to the software right away, so that they as soon as possible could make up an opinion about the new system's possibilities in a Cuban context. A reasonable argument, but it was hard for us to give the DNE staff a deeper understanding of the database system without any Cuban data. In addition, we argued that a deeper understanding of information systems is needed to be able to decide whether the system is suitable for Cuba or not. The staff at the DNE does not have sufficient understanding in this specific area and there was a need to involve Cubans outside the DNE that had more skills in information systems.

Design and implementation of a provincial approach with the minimum dataset, Sept. -Nov. 2002

During the first fieldtrip, we developed an essential dataset and a prototype database to be used to implement what we call the essential dataset approach. It was an approach that targeted at achieving complete data coverage from both provinces, as well as facilitating local use of information were we had computers installed. Our task was to implement this approach in all selected pilot sites in the two provinces, Matanzas and Sanctí Spíritus. The implementation process consisted of four main tasks;

- To provide a local level learning process building local capacity
- To gain more knowledge about the local health information processes
- Based on increased understanding of local processes, improve the system and make more tailored solutions at all levels
- Maintain the new database system

For two months we travelled around in the two provinces working on the tasks above, and we visited most pilot places twice. First we did a visit as early in this period as possible to start the training process, and some weeks later a follow-up visit to continue the training. We experienced that the training process was very time-consuming and we neither had the time nor the resources to go through with all the planned training tasks. Despite this, we managed to get all local staff up to a basic level in the use of the system and in some places even educate a few advanced users.

One of the main goals for the training was to teach the statisticians how to enter data into the database, an important first step to get the Cuban database up and running. With Cuban data in the database, the remaining training process was much easier, given the possibility to do demonstrations and exercises with familiar Cuban health data. Travelling around in the provinces, we encouraged the local workers at health units, at the municipal offices, and the provincial offices to participate in the design process to make the system more tailored to each place and to secure local ownership to the system. During these two months, we had a strong focus on local implementation and as a consequence the national level in Havana was not much involved in the process. The essential dataset approach will be described in more detail in section 7.4.

Centralised maximum dataset approach at the national level, Nov.-Dec. 2002

In November 2002, the DNE complained that they had lost control of the development process, they wanted a more centralised approach, and they especially disliked that local workers were getting more skilled in the system than they were. After discussions at the DNE with the National Director of Statistics and the Norwegian senior researcher, there was a shift in the development strategy towards a more centralised approach. The DNE in Havana stopped the local development processes in the two provinces and the focus was now 100% on developing a database system that suited the needs of the top levels of the hierarchy. The DNE stressed the need for more knowledge transfer at the national level, and we started to design a new database based on a maximum dataset approach at the DNE with participation of the national staff. This change in approach will be described in more detail in section 7.4.3.

6.2.5 Latest developments, Jan.-Oct. 2003

In December 2002, the two authors finished their project period and another Norwegian master student, Pål de Vibe arrived in Cuba to continue the Norwegian participation in the project. A national hospital database based on the new strategy with maximum datasets was developed during the first months of 2003, a database tailored for the national and provincial levels.

In April 2003, the DNE decided to roll out the hospital database to all 14 provincial offices, equipping each office with two of the donated computers. These good news

were not to last, and when de Vibe returned to Norway at the end of July, the latest news from the DNE were that the roll-out of the hospital database is not likely to happen and that all project activity had been stopped. We were informed by good sources that a new major health information system project had been initiated, and that the new visions of the Ministry was to develop a huge web-based modern system that is to incorporate all reporting units and be up and running 24-7. These plans were not yet official, but our sources are good and this seems to be one of the major reasons for shutting down our project prior to the expiry of the agreed project period.

In October 2003, on his way to a conference in Costa Rica, on of the IS researchers from the University of Oslo engaged in the HISP initiative, stopped by the DNE office in Havana for a short unplanned visit. From these latest talks we can conclude that the Cuban HISP is finished. The DNE management partly blamed bad timing as the reason for not continuing the project, and he explained that an ongoing reform process in the Cuban health system makes it difficult to start new projects at the moment. He opened for the possibility to take up the HISP activities some time in the future, but did not promise anything.

6.3 Political brokering at a global level

Cuba's special political setting with strict control of foreign investment, unpredictable politics towards foreign involvement and a powerful U.S. anti-Cuba campaign makes it a challenging country for collaboration projects. Based on our experiences from working in Cuba we will look at how this political environment affected our project.

The following subsections will be presented:

6.3.1 - Struggle to get access
6.3.2 - Unpredictable Cuban politics
6.3.3 - Embargo problems

6.3.1 Struggle to get access

As described in section 5.3.5, the Cuban government is extremely careful in controlling foreign investment, and the strict control mechanisms with several levels of bureaucratic instances will to a foreign project worker, sometimes feel a bit exaggerated. The way the project has been affected by this complicated political environment has firstly been the problem of getting access to research. Obtaining visa and working permits has been a struggle from day one in the project.

During the first visit to Cuba in June 2002, we planned further project actions with the DNE management. To the suggestion that the Norwegian Project Coordinator could stay in Cuba for about four months, we received only positive reactions from the Cuban side. It was also planned that the two Norwegian students would stay 3-5 months in Cuba from September. However, during the two months back in Norway, things changed rapidly in the Cuban Ministry of Public Health (MINSAP). In August there was an intense discussion between the two project coordinators from Cuba and Norway about the engagement of Norwegian project workers in Cuba.

Before leaving Cuba in July, we had planned with the DNE that they would contact us during the summer to organise the paperwork considering visa and working permits, and to set up a more detailed plan of our stay. However, by mid August we had still not heard anything from Cuba, and we knew that visa applications take time and that we were in a hurry to get visa for the next visit. We contacted the DNE by e-mail and attached a proposal for our working plan for the upcoming stay in Cuba outlining a stay of 3-4 months, and in addition the Norwegian project coordinator outlined his plans for working in Cuba.

In short time, the DNE could inform us that our project plan was under analysis in the Project Office at the department for international relations within the MINSAP, and that they considered the time-span of our stay a bit long. The DNE added that we should have in mind that since it had been signed a *terms of reference* paper, MINVEC now had to deal with all administrative and cooperative work. We saw this as a clear message from the DNE that they had lost authority over the project planning. All our suggested plans had been discussed during the stay in June and should not have presented any surprises to the Cuban side.

This message was followed by a series of e-mails between the DNE and the University of Oslo and the optimistic atmosphere from some months back was completely vanished, and we started to get the sense that the project was loosing priority in Cuba.

During these rather intense discussions the DNE wrote in an e-mail that they wanted to make some reflections; here is a selection of those:

"Cuba has powerful, well defined and comprehensive health information system capable to satisfied information needs at different level within the framework of the National Health System. The Cuban Health information system and DHIS are not incompatible, but DHIS activities as a project activities can not emulate or make interferences to the normal system, then DHIS working plan have to be moderate, steadily and focusing particular needs of Cuban technicians."

"Cuba has in the field of Health Statistics nationwide well-trained human resources but little skills in the field of Information Technologies. On this matter, we need as a first step to train a national team with some provincial participation, and later on start a process of training in lower levels. This training does not need to be done exclusively by the Norwegian team. Cubans have to be involved in such training since the very beginning."

To these reflections, the Norwegian project coordinator replied:

"The condition for embarking on such a venture is that a solid team is established in Cuba and that this Cuban team does the bulk of the work. In addition, that good collaboration is being established between the Cuban and the Norwegian team, and with other partners in the HISP network. The Norwegian collaboration is basically meant as transferring skills and technology to Cuba."

The 5th of September, in an e-mail, the DNE informed us about the final decision taken by the Project Office at the MINSAP:

- The two students are allowed to stay in Cuba under the following conditions:

    - The working period has to be fixed between September 15 and December 15
    - Considering the long term of the stay the students have to financially cover their stay
    - No vacations or holidays are accepted during the official working period (Sept. 15 – Dec. 15)
- The stay of the Norwegian project coordinator was rejected
    - He is allowed to come for shorter visits to supervise the project in correspondence with the signed terms of reference paper.

We were later told that the Norwegian project coordinator was not allowed to stay in Cuba for more than two weeks at a time, in contrast to the planned stay of 3-4 months. The differentiation between master students and an authority-person is worth noticing, rejecting involvement of a researcher with lots of international experience could indicate a fear and scepticism of foreign involvement, a professor obviously presenting a bigger risk to the Cuban system than two students.

Another example of how the Cubans like to control foreign collaborations is the way they suddenly were taking full control of our stay, indicating that we as voluntary project workers were not given the freedom to take some days off work during the three months stay.

6.3.2 Unpredictable Cuban politics

In section 5.3 we have described the political context in Cuba, and pointed out that the political actions can be unpredictable. To a large extent most of the bigger decisions are taken by Fidel Castro alone, and as implied earlier his decisions can be very drastic and seem spontaneous. As we have described in section 5.3.5, the political context for foreign projects and the official Cuban attitude towards foreign involvement are both varying and changing from year to year. Here we will give some examples on how this particular political context affected our project.

Political change in the Ministry of Public Health (MINSAP)

In July 2002 a small revolution shocked the administration of the Cuban Ministry of Public Health; about 80% of the administration in the MINSAP was sacked and replaced, including the minister and most of his vice-ministers and national directors. Less than a month earlier we had left Cuba and the MINSAP without any news on the upcoming changes, not even the DNE management knew about what was going to happen. Not in many countries in the world, such a change is possible, but in Cuba this was done by one man with full authority, the president Fidel Castro.

We heard that one of the reasons for this change of administration is that the old minister had too many foreign projects going on, and the first thing the new minister wanted to do was to shut down all these projects. Another explanation was the tense political climate in Cuba due to increased U.S. pressure after Bush included Cuba in his Axis of Evil (5.3.4). Our contact, the DNE direction, was amongst the few sectional directions that remained in place after this drastic change process, and they managed to convince the new minister not to shut down our project. Still, the new political

conditions in the MINSAP did slow down the project's progress significantly, without the strong support we had from the old minister.

The DNE direction survived these administrative changes, but their boss and most of the other co-directions did not. The DNE direction had full trust in the old minister and was given, in a Cuban context, a free hand in decision-making considering our project. With the new minister, who wanted to shut down the project right away, the DNE told us that they had to be much more careful considering any project actions. At this moment it was definitely not a political environment for promoting large scale foreign projects and change process.

These administrative changes in the MINSAP have been extremely unfortunate for the project, and the situation before this incident were completely different with a much broader support in the MINSAP. In the new situation the DNE direction wanted to keep a very low profile and has tried to make the project as small and silent going as possible. This has resulted in restricted access and engagement of Norwegian project workers and a much more limited pilot area than first agreed on.

Problems with contracts and long-term commitment due to varying attitude towards foreign investment

As outlined earlier, the varying political environment and especially the changing attitude towards foreign projects make long-term agreements difficult. From our project experience we can say that we signed a contract in a good period concerning foreign projects in the MINSAP, but after just a few months the political setting changed dramatically with the political change in MISAP. This lead to a general mistrust towards foreign involvement, and suddenly it was difficult for the Cuban part to follow up earlier agreed plans.

In June 2002, the Norwegian project coordinator signed a *terms of reference* paper (see Appendix D) that explains the project, its objectives, economical framework, and time span. The DNE director, as well as representatives from the MINVEC and the MINSAP signed this paper, which in June 2002 was needed to continue the project. This contract is very specific about economical contribution from the Norwegian side and has figures on all donated hardware and project workers salaries. The Norwegian side understands this *terms of reference* document as a type of contract with certain obligations attached to both sides. We had many discussions with the DNE direction considering the expansion of the pilot sites, and we argued that we should keep to what we had agreed on earlier. Once during a discussion at the DNE office, we referred to the *terms of reference* paper as a contract, and the Cubans went furious and said that the word contract disgusted them. The DNE direction had become true politicians using the *terms of reference* paper exactly as it suited them, and they did not give in for any of the suggestions from the Norwegian side of the collaboration. The DNE direction has told us that the *terms of reference* paper is not a contract, and they have convinced us that it is more a document to please the Cuban bureaucracy than a formal project plan. In practice, to us this paper has caused an extremely difficult process to obtain visa and working permits due to the complex bureaucracy involved, and when it comes to project planning we have been totally overruled by the DNE direction's selective understanding of the paper. We have asked for a contract to formalise planned project actions, but the Cubans are not interested in any obligations. For the Norwegian side to invest more

money in hardware and accessories there was an obvious need of some kind of obligations from the Cubans to go through with planned project actions. This difficult problem remained unsolved, and the urgent need for buying e.g. UPSs to protect the computers against a poor electricity infrastructure was never met.

6.3.3 Embargo problems

We have had some personal experiences with the U.S. embargo, both complicating Norwegian donations of hardware and access to software and computer accessories. In section 5.3.3 we described how the embargo also applies to U.S. software products like Microsoft Windows and Office. Unfortunately, these software packages are necessary to run the database system we were developing, so we had to find a solution. As explained, this was finally no problem at all, as pirate copies of Microsoft products are widely used in Cuba. In fact most versions of Windows and Office have links for download at the intranet of the Ministry of Public Health.

While working on adapting the database system we programmed an additional system module in Java, and to run that module we needed the Java Runtime Environment package developed by Sun Microsystems, a U.S. company. This package is free software available for download at e.g. Sun Microsystems' homepage (see Figure 14 below) or CNet's http://download.com, but both these sites have restrictions on letting Cuban servers download software. We got an error message informing us that due to U.S. export regulations to Cuba this software could not be downloaded by any Cuban server.

Another example on embargo problems is how the University of Oslo will not donate any Sun equipment to our project, even equipment that is being dumped or given away to students. They will not take the risk of being responsible for exporting U.S. hardware to Cuba. Luckily, other Norwegian companies do not care about these export regulations and have donated U.S. produced hardware.

Figure 14. Export denied. Sun's website.

Explanation: from Sun's download site: "We apologize, but we are not able to service your request due to U.S. export regulations".

6.4 Summary

The terms of reference paper outlines that the main objective of the project is to strengthen the Cuban health information system by developing a database system based on the DHIS software. Furthermore, this database system must support analysis and local use of data, as well as and management and decision-making at all levels in the health system.

We have seen that the project had a good start in May 2002 with a broad political support and an optimism that resulted in the *terms of reference paper*. Later, a political change in the Ministry made the project a more low profile research project with limited resources provided by the Cubans. Anyway, we managed to develop a database system targeted at the needs found in the two pilot provinces and had a fruitful fieldwork out in the two pilot provinces. Lack of political support at central level scaled down the project considerably in December 2002, and after the last Norwegian left Cuba in July 2003, the project has been shut down.

During the project we have experienced some of the special Cuban political context with a constant struggle to get visa and permission to do research in Cuba. We also experienced how difficult it is to have official contracts to work by; the *terms of reference paper* that at first was a very official contract, was considered as no more than guidelines after the project had lost political support.

The next chapter will look in more detail on how we approached the objectives, and how the process of systems development was continuously affected by this unstable political context.

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7 Development of a Cuban HIS

In this chapter we will describe the systems development processes of planning, designing, adapting and implementing a new Cuban HIS.

We start this chapter by presenting the software tool that we have used to develop the Cuban HIS. Subsequently, we describe the planning process, how we set up a strategy to meet the objectives. The objectives call for a strategy to equally meet the needs of the central and the local levels, an objective that is difficult to realise in practice. We will describe how the pilot sites were selected and the computers allocated in the two provinces, an important factor concerning the approaches we developed.

An important part of the HISP transfer process is to translate the software to Spanish. The software has a multilingual module that facilitates rapid and easy translation without having to touch the source code. Still, the translation was a comprehensive and time-consuming process.

Based on the approach we designed a database system that was tailored to the different levels, and in order to do this we were dependent on participation from the local problem owners. The other main development task, in addition to the design, was to facilitate a learning process to develop a sustainable Cuban system. We experienced that the political support to facilitate resources for learning was not always there, which made it difficult to meet the objective of transferring sufficient knowledge to make the Cubans capable of maintaining the system.

While implementing the system out in the various pilot sites we have experienced many challenges related to the Cuban infrastructure. A huge petrol crisis, lack of paper, poor telephone lines, electricity black-outs and difficulties of obtaining spare parts for computers are some of the challenges we met. We have worked in many different pilot sites and have experienced interesting differences at the different levels and between the provinces.

The following sections will be presented:

7.1 The database tool – DHIS

We have used the DHIS software to develop the HIS in Cuba. The software is more a database tool than a finished database application, as it provides only the skeleton for building a database, as well as features to enter, process and present data.

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 new versions. During our fieldwork, we have used versions 1.2 and 1.3.13.

The software has several properties that make it suitable for adapting to a new context;

1) It is a prototyping tool, which means that it supports fast and easy set up of a prototype database structure that can be used quickly.
2) It supports an evolutionary prototyping strategy for systems development with its flexibility and prototyping properties.
3) The software is multilingual, using a separate multilingual module for fast translation to any language.
4) The software is a free and open source product

The software is programmed using Visual Basic (VB), and run in a Microsoft environment with Windows, Excel and Access. The negative consequences of this choice of platform, is that it is dependent of expensive Microsoft licenses, and in the case of Cuba it cannot be legally used due to U.S. export restrictions. However, as we have explained, the extensive use of pirate copies solved this problem.

As mentioned above, the software is a free and open source product. This allows any interested developer to use the source code of the program. This opens for a flexibility to add new modules, fix or improve old modules, providing the possibility to tailor solutions for local adaptation or involving a global network of developers in improving general features of the software that are valuable to all DHIS users world-wide.

7.1.1 Architecture and features

System architecture

Figure 15 illustrates the software's architecture, and as we can se it is separated into front-end and back-end files. The software is a stand-alone database application meaning that all database definitions and populated data is stored on the local machine.

The front-end files hold the user-interfaces and control all interaction with the users, and the back-end file stores all locally customised definitions and populated data.

The main application is the Access MD module, and this 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.

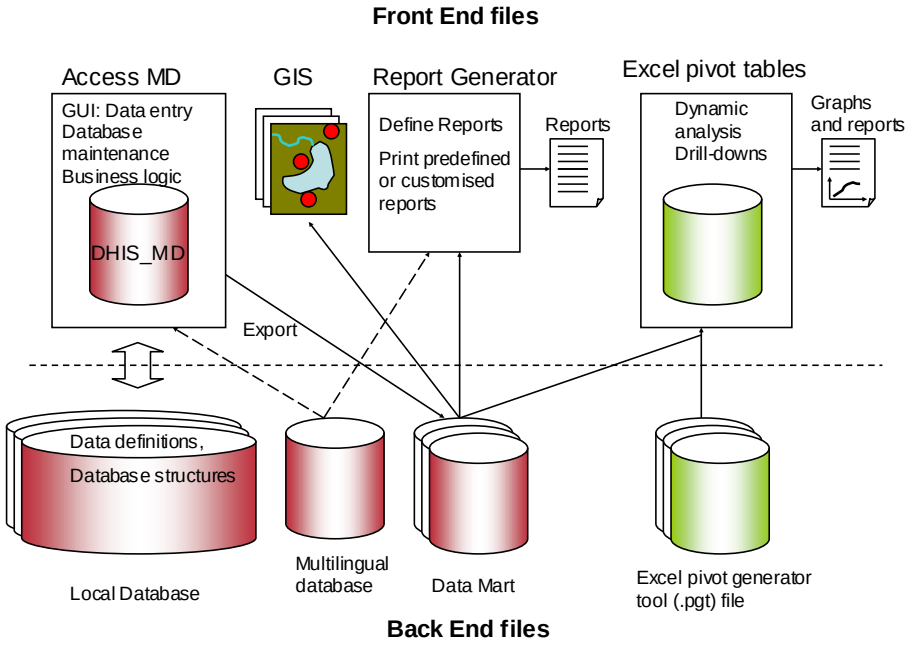


Figure 15. DHIS architecture

Explanation: Illustrating back end/front end in the database tool

The most important administrator features are the design interface for building a local database. The low-level database architecture with tables and relations is already in place, and there is a graphical interface for high-level database design, which then is limited to building the database reporting structure with all reporting units and the datasets with all data elements to report. Furthermore there are possibilities to define validation rules, organisation unit data, population data and calculated indicators. The font-end database file DHIS_MD holds all programming logic and database architecture for the Access MD module. All the local information, as the definitions of local database reporting structures, datasets, indicators, validation rules etc. are stored in back end local database files. The Access MD module is multilingual and all text strings in the user interface are taken from the back-end database file HISP_ML that stores all the strings in any desired language.

The analysis is mostly done in either the report generator (Access RG module) or in pivot tables in MS Excel. As we can see from Figure 15 the report generator and the pivot tables get their data from an Access database file called the data mart. Each local database file has its corresponding data mart file which holds the data entered into the local database as well as the calculated indicators. These data mart files however have an architecture that permits much faster access to data and is especially designed for fast database querying which is needed when analysing large amount of data.

System features

Access MD (Monthly Data) is the module for entering and reporting health data on a monthly basis. This is the only supported reporting frequency in the current version of the software as this is the frequency used for routine health data in South Africa. It is possible to work around this rule if it is desired to report at a lower frequency like on a

quarterly or yearly basis. However, it is not possible to report at a higher frequency, like weekly or daily.

The Spanish version's front page is shown in Figure 16. The user interface is graphical, allowing users to navigate by mouse, an important aspect for user friendliness. Figure 17 shows the data entry form in Access Monthly Data. This module can also be used to some simple analysis, and report writing.

To facilitate reporting of data between the local databases there is export/import functionality that allows for data reporting on a small-size ASCII format by e-mail, floppy or other transportable storing devices. The current version of the software only supports monthly data reporting.

Data from the Access Monthly Data can be exported to the corresponding data mart file in a customised way selecting what data to export.

The report generator allows specified report templates to be made that can be linked with the most updated data on a routinely basis. The users can design their own customised reports using any health unit or administrative level, a desired selection of data element or indicators at the desired level of aggregation for the desired period.

The Excel pivot tables represent a powerful dynamic analysis tool. All the entered data as well as calculated indictors can be linked to the dynamic pivot tables through the exported data mart file. An important analysis feature is the possibility to do drill-downs, meaning that the same data can be viewed at different aggregated levels, all the way from a national overview to the most detailed local-level presentation. To present data from the pivot tables the integrated graphs in Excel can be used. Graphs can be altered and changed in the same way as pivot tables. Finally, a powerful analytical feature is the possibility to export data to ESRI Arc-Explorer, a GIS-software that is part of the DHIS installation package providing geographical data analysis. In chapter 8 we analyse the Cuban data and make use of the analysis features of the software.

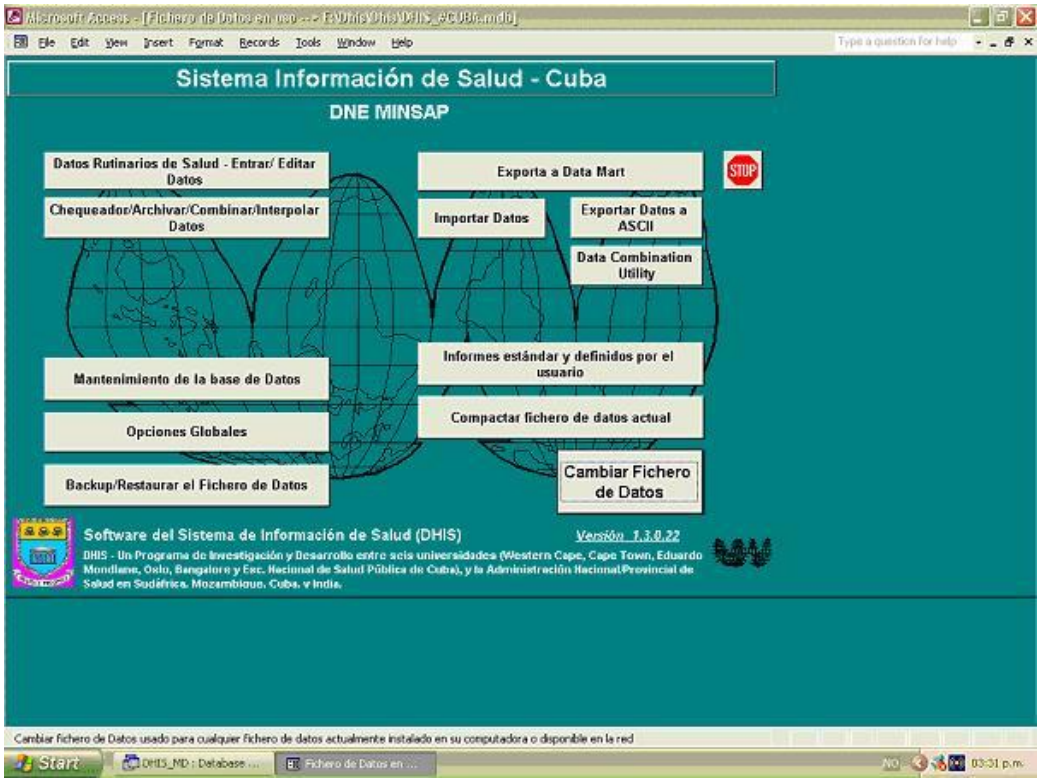


Figure 16. DHIS MD front page

Explanation: access Monthly Data module. Contains all database editing tools, as well as data entry, data import and export, and simple and easy analysis and report writing options

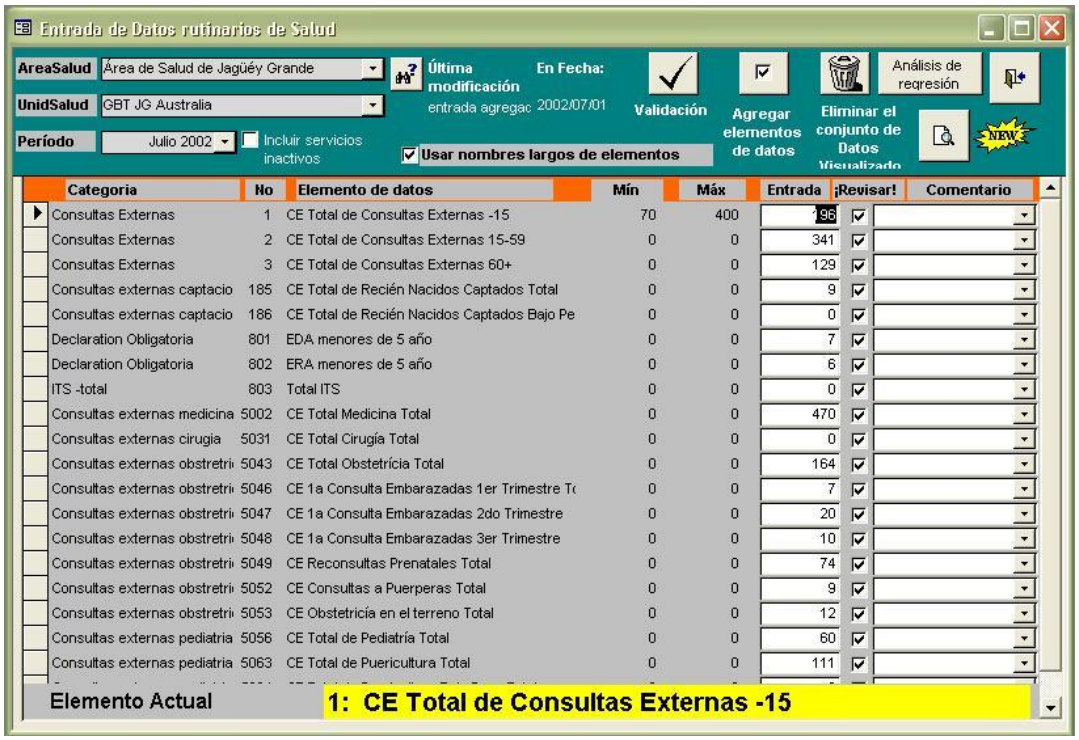


Figure 17. DHIS data entry form

Explanation to figure: the data entry page of the DHIS Monthly Data module. The graphical user interface makes it easy to choose health unit (UnidSalud) and period (Período). The Min and Max columns are the first validations, checking for "strange" values and typing errors.

Multilingual software

Providing software in the local language is crucial when aiming to support a global network of developing countries form all parts of the world. The DHIS as it was originally solely a South African system was at first hard-coded with English text strings. Facing the challenge to start another HISP project in Portuguese-speaking Mozambique the HISP team first started to hard-code a new version in Portuguese, but during this difficult and time-consuming task they come up with the idea to develop a separate multilingual module. The HISP.ML database file (see Figure 15) stores all the text strings that are visible in the interaction with the users and the text strings are taken from the multilingual module by the use of queries. This database can hold these text strings in any language or alphabet supported by Windows, thus the UNICODE standard. To translate the software, it is no longer necessary to look into the code or any technical system-specific parts; the task is basically to translate a long list of text strings to the desired language. The software follows the regional options of Windows and presents the program in the language corresponding to the location the user has chosen, given that the translated strings are in place. This multilingual module has the great advantage of being able to translate the software without having to look into the technical aspects of the system, actually without even knowing the software.

7.1.2 Designing a database with the DHIS tool

As we have described, the software is a database tool that is more like a skeleton of a database than a pre-made solution, and to users with administrator rights there is a high-level design interface to create and maintain local databases.

To design a functioning database with the use of DHIS there are two main “pieces” that must be developed, a database structure and a dataset. The database structure holds the real-life health structure with all the reporting administrative levels and health facilities, and their hierarchical relationships. The dataset is a collection of data elements, the different health data that is to be collected and stored in the HIS.

The databases are stand-alone databases at each unit, hence they are not physically linked together in a computer network. In a DHIS network all clients have their own local database file and definitions, and the networking is organised through the use of common definitions of database structures and datasets. To facilitate reporting from a local polyclinic to the national level, the polyclinic and all the different administrative levels to the top must share the same database definitions in the local back-end database file (see Figure 15). To secure consistency in this network of stand-alone databases there is an absolute demand that all units have the same set of database definitions or standards as the level above. However, the software offers flexibility to all levels to make additional local standards as e.g. new data elements, indicators and validation rules to the set of standards that is inherited from the parent unit in the reporting hierarchy. This local flexibility is an important strength of the DHIS that makes it well suitable for supporting a district-approach to PHC (2.3.3). Figure 5 in section 3.2 illustrates such a hierarchy of standards.

Designing database structures

The database structure consists of a hierarchy of organisational units that are either administrative units or reporting health facilities. The relationship between the units must be defined in parent-child relationships that make up a hierarchical structure.

There are some constraints related to the design of database structures. The skeleton database structure that is common for all local databases consists of five hierarchical levels and only admits data entry at the lowest level. These properties reflect the situation in South Africa when the software was prototyped to the South African health system. The South African health system has five hierarchical levels, four administrative (Nation, province, municipality and district) and one level of health facilities below the districts. Another factor that is reflected in the design is that the software was developed with the objective to support district health management. The decision to only allow data entry at the lowest level was basically a "political" decision to ensure that the hospitals report through the district structure. Hospitals are generally strong units that tend to outmanoeuvre the district management teams. If they are "forced" to report through the districts, that may eventually strengthen the districts.

This rule can be problematic when creating a national or provincial database for other types of health data than just PHC-data. Units like national or provincial hospitals or major psychiatric institutions are subordinated by higher levels than the district and are found higher up in the hierarchy than the lowest level. Following the rule of data entry only at the lowest level would exclude data entry from these units. However, we have managed to work around this problem and found temporary solutions (see Appendix B) that work fine until a newer release of the software will address this problem. The constraint related to a fixed five level structure can easily be overcome when there is a need for hierarchies with less than five levels by the use of dummy levels at the top (see Appendix B for our Cuban workarounds to this constraint). However, at the moment there is still no support for hierarchies with more than five levels.

Logic behind the data elements

Ass mentioned above, all local databases in the hierarchical reporting structure must share a set of common standards for database definitions to be able to receive and report data in the hierarchy. The data elements that are entered, analysed and reported in the database hierarchy are called a dataset. The logic behind the datasets follows the logic of common standards as described above; all units that want to report or receive data must use the same standards for data elements as the others in the reporting network. There can be standardised datasets for the whole nation, for a province or a municipality, as long as all units in this group or sub hierarchy uses the same standards.

Aggregation problem addressed in software

In section 2.3.3, we described the problem of too aggregated data and little useful information for the lower levels in HISs. The DHIS software is focusing on the district health management and has addressed the problem of aggregation explicitly. As mentioned above, the software only permits data entry at the facility-level. An administrative unit cannot aggregate local data reported from the level below and enter these totals into the database. Instead, they have to import the data just as they are received from the level below. This means that data is stored at the aggregation level

equal to the lowest level in the database structure all the way to the top of the hierarchy. In this way, the national level will have detailed information about the local facilities at the bottom of the hierarchy in their national database.

However this detailed data is seldom interesting for national decision-makers, and to satisfy the need for analyzing aggregated data and comparing districts and provinces, both the report generator and the pivot tables provide flexibility in grouping data to whatever level the user would like. Data will always be stored in the database at the lowest possible level, but the user can group data and aggregate in a customised way to fit the personal analytical needs.

7.2 Development approach

Scale and sustainability

Our most important objective was to develop a sustainable computerised national health information system based on the present Cuban HIS and with a focus on local use of information. Furthermore, the system should support health management at all levels in the health system, and facilitate the use of an essential minimum dataset and indicators. Based on previous HIS development projects (ref. 3.3), we argued for an approach with sufficient scale, as coverage has proven important in order to achieve a sustainable system. This applies to both coverage of health units and coverage of data elements and indicators. As an example, when piloting in a province the database system first becomes interesting to the provincial administration when it covers the whole province, *and* the appropriate dataset, and thus provides meaningful information to them. Provincial support and commitment is the basis for making a sustainable provincial system, and without scale this commitment is hard to obtain. Scale is then closely linked with data coverage in a database system, and as more units are reported into the database, the system becomes more interesting and eventually sustainable.

When developing an approach to achieve this scale and sustainability there were many factors to consider; the number of municipalities, the amount of computers, the size of dataset to report, the level of aggregation, the paper use, and the central needs for control.

Decision on provincial coverage

The DNE selected Matanzas and Sanctí Spíritus as the two pilot provinces and these provinces have 14 and 8 municipalities respectively. The DNE suggested involving only one municipality within each province, clearly not aligning with our wish to achieve sufficient scale and provincial coverage. We argued that such provincial database only involving 1 of 14 or 1 of 8 municipalities would be of no interest to anyone outside the two municipalities. The DNE loosened up on this initial suggestion and agreed on involving more municipalities in Sanctí Spíritus, but limit the involvement in Matanzas to only two municipalities. However, we did not have the resources to involve all these municipalities with only 11 computers available at this time. The DNE wanted to distribute the computers equally between the two provinces despite the difference in coverage, and this resulted in 5 computers to Matanzas where we would involve two municipalities, and six computers to Sanctí Spíritus where we could involve all 8 municipalities.

Deciding on how many municipalities to involve has been a political issue in Cuba. The DNE at the national level wanted to have full control of the project actions, and by involving only a few municipalities in a large province they would be in charge of all actions. On the other hand, by involving all municipalities they would make it a provincial project since the provincial office would suddenly be much more interested and engaged in project actions. We will give more examples on how this central need for control has affected the possibilities of local commitment in section 7.4.4.

Achieving coverage and local use despite limited resources

– a combined paper-based and computerised reporting system with an essential minimum dataset

With limited computer resources we found it challenging to approach both the objective of improved local use of information and the need for sufficient scale. In this trade-off situation the level of aggregation (2.3.3) is the determining factor, as an approach to obtain full coverage with few computers argues a higher level of aggregation, meaning fewer units to report, and a focus on the local level argues a low level of aggregation to provide useful local information.

The Norwegian side suggested using paper-based reporting from the municipalities that would not get a computer, and thus achieve full coverage in the two provinces. The DNE rejected a paper-based reporting system in the Matanzas province, as they did not want to involve more than two municipalities there. In Sanctí Spíritus that has fewer municipalities, they opened up for a paper-based variant as long as the provincial office supported this approach.

Such a combined paper-based and computerised reporting system would mean that the provincial office would have to enter all the data reported on paper into their provincial database. We had to make sure that this job was manageable to the provincial staff, by limiting the amount of data to enter. Another limitation we had to consider was the serious lack of paper that Cuba is suffering (ref. 5.3.2), so we had to reduce the paper use. There are two factors that decide both the size of the reports and the workload to enter the data; 1) the size of the dataset to report, meaning how many data elements, and 2) the number of units to report. While the present Cuban HIS is based on large datasets following a more data-led tradition to serve monitoring needs at the top levels (5.5.6), the HISP philosophy is to use small essential datasets following an action-led variant of an HIS that supports local use of information. The number of units to report is determined by the level of aggregation, meaning at what level the data has to be captured. The Figure 18 below explains the relationship between the size of the dataset, aggregation and data quality.

To be able to maintain good quality data with a large ‘maximum’ dataset there is a need for higher aggregation levels and a higher level of data capture. To provide information-support at the local level the aggregation level must be low. A lower aggregation level demands a smaller dataset to provide quality data, and it is impossible to provide quality data when having both a low aggregation level and a large number of data elements.

Two important decisions had to be taken; how many data elements to report and at what level should the data be captured. Based on our objectives and the logic seen in Figure

18 we agreed on using an essential minimum dataset that would facilitate a lower level of aggregation. Especially the need to reduce the use of paper made the Cubans go for an essential minimum dataset, an approach that is quite different form the one found in their present system.

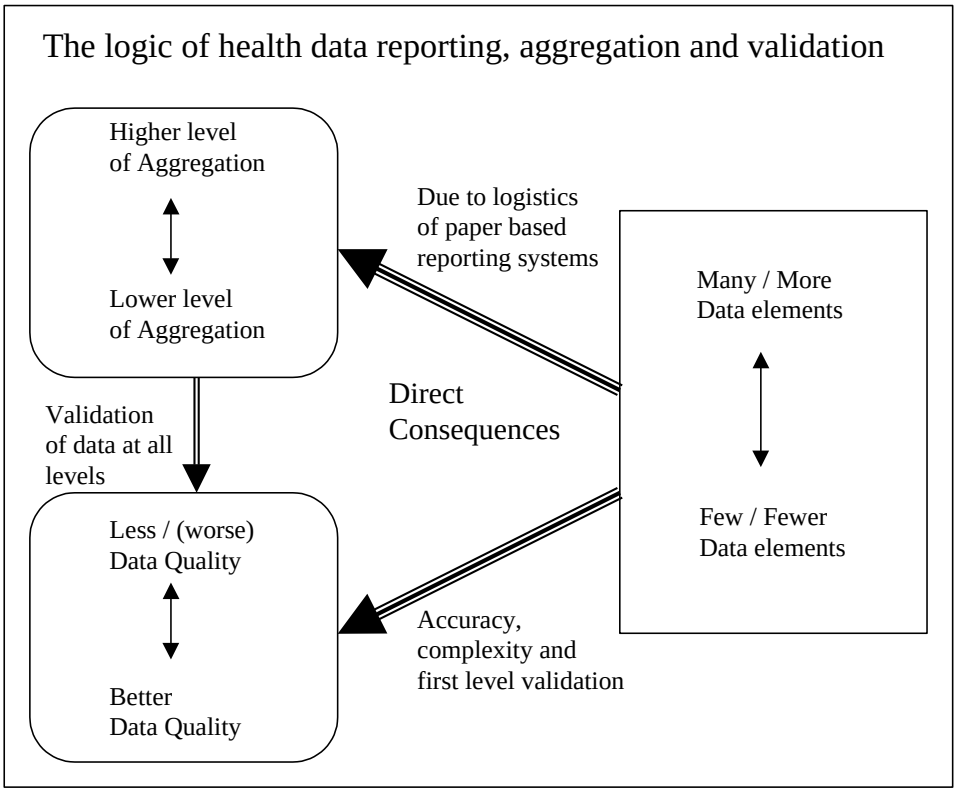


Figure 18. Dataset logic

Explanation: The logic behind going for an essential dataset and the working groups as data capturing unit (Braa, Sæbø, and Titlestad 2002)

Given the small dataset we had to find an appropriate data capturing level, which means that the number of units to report had to be kept low to save paper and limit the workload of entering data, and at the same time we wanted to focus on local needs of information and thus do the data capture as far down as possible. To explain how we made the decision we will review the Cuban hierarchical health structure. As seen in Figure 19 below, the hierarchy concerning PHC data (ref. 5.5.7) is a bit more complicated than other routine health data. The health areas provide PHC services in their internal structure with working groups and family doctors, while other routine data comes directly from the health units that are subordinated the municipal offices and not part of the PHC structure.

Considering routine data that are not PHC data the decision was easy to make, we would do the data capture at the health units level. This means that the municipal office or the provincial office has to enter data from each health unit in a municipality separately. Concerning the PHC data it was a more complicated decision, as there were more levels to consider. After visiting some of the health areas and the family doctor offices in the two provinces, we thought that the family doctor offices would be the best data capturing level considering their value for local information use. However, as we can see from Figure 19, using this level would mean far too many units to report (30

offices X 4 groups X 4 areas) to enter both at the municipal office and the provincial office.

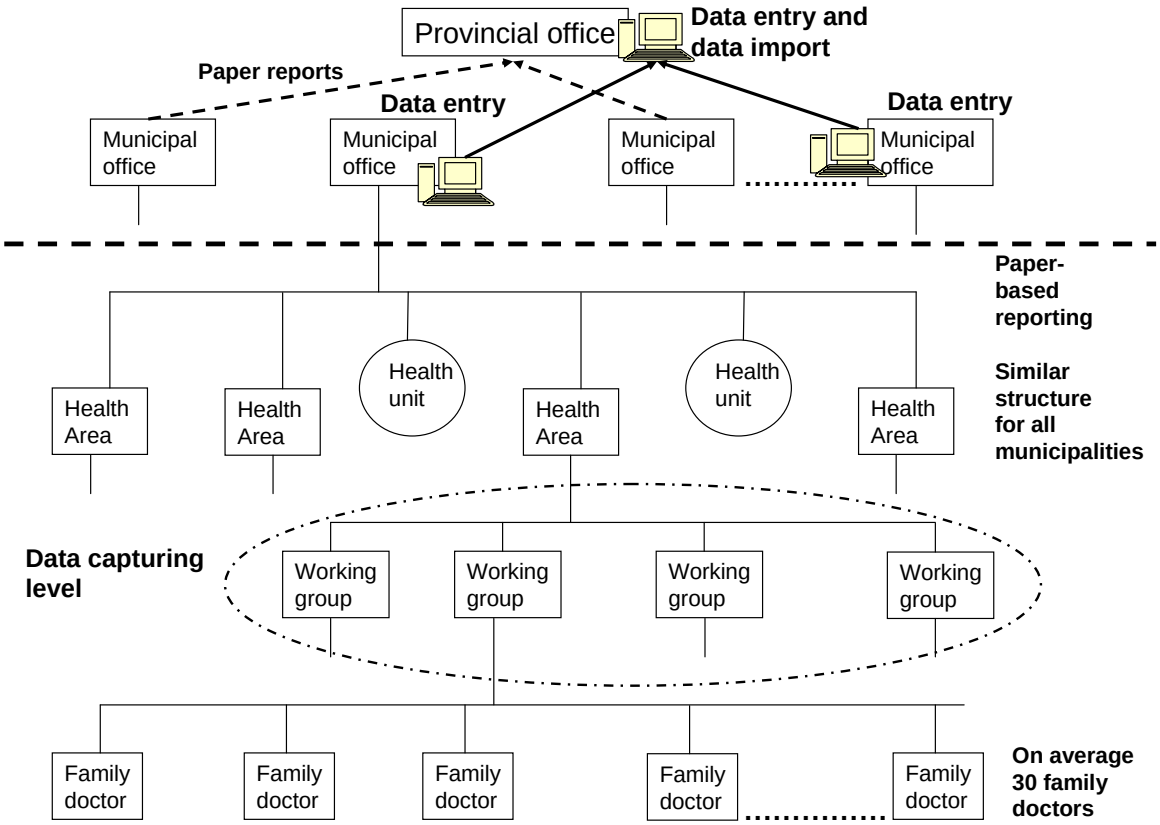


Figure 19. Provincial reporting hierarchy

Hence, the working group level seemed more appropriate, limiting the number of units by a factor of 30. This amount of PHC units, on average 16 for each municipality, plus 5-10 other health units is a manageable number of units to report to the province. Using a minimum dataset with less than 50 elements these data would fit on one page and save paper, as well as be a manageable job to enter at the provincial level.

The provincial approach with an essential minimum dataset

Adding these decisions together we have the provincial approach that was developed at the DNE in June 2002. Important decisions are the use of an essential dataset, data capture at working group or health unit level, a mix of paper-based and computerised reporting to achieve full provincial coverage and the focus on local use of information.

The DNE decided to put 5 computers in **the Matanzas province** and only involve the two municipalities Jagüéy Grande and Ciénaga de Zapata. Despite the fact that the DNE had rejected paper-based reporting in this province, we made a compromise and found a way to get full coverage with more aggregated data. Instead of reporting on working group and health unit level as suggested in the provincial approach, we arranged that the municipalities could report only their municipal aggregates, the kind of data they already report in the present HIS. This level of aggregation would mean less information for local use, but a full provincial coverage in the database system. In order

to use these aggregates in the provincial database we developed an additional database that was adapted to this type of data.

Covering the provincial and the two municipal offices in Matanzas there were still 2 computers left to use, and these were put in a polyclinic and a municipal hospital in the Jagüéy Grande municipality. While at the same time focusing on full data coverage for the province given a limited number of computers, we also wanted to improve local use of information as far down in the hierarchy as possible. The two local units in Jagüéy Grande would then facilitate the development of a local HIS tailored to the local units, however these locally adapted solutions would still be an integrated part of the provincial approach. We knew that more computer donations from Norway were possible, and then more local units could be equipped with computers and use a locally adapted database solution. How we adapted the provincial database to a more polyclinic and hospital specific system is described in the design section (ref. 7.4.2).

In the **Sanctí Spíritus province** we had 6 computers available and 8 municipalities to cover. In addition to include all the municipal offices, we wanted to put a computer in a polyclinic in one of the municipalities, to meet the objective to strengthen local use of information and have some local development experiences from this province as well.

We set up one computer in the provincial office and another one in a polyclinic, and then we had four computers left and eight municipal offices to cover. To achieve full provincial coverage we suggested to use paper based reporting from the municipalities that would not get a computer. The provincial staff in Sanctí Spíritus would get some extra work entering data from four of the municipalities, but they liked the idea full provincial data coverage in their database. The municipalities Fomento, Yaguajay, Trinidad and Sanctí Spíritus were equipped with a computer as well as a polyclinic in Fomento. In addition, we implemented the system in the Mayajigua polyclinic in the Yaguajay municipality, an office already equipped with a computer.

Figure 20 below illustrates the provincial approach with both paper-based and computerised reporting to the province and also the development of more locally tailored approached to the local units.

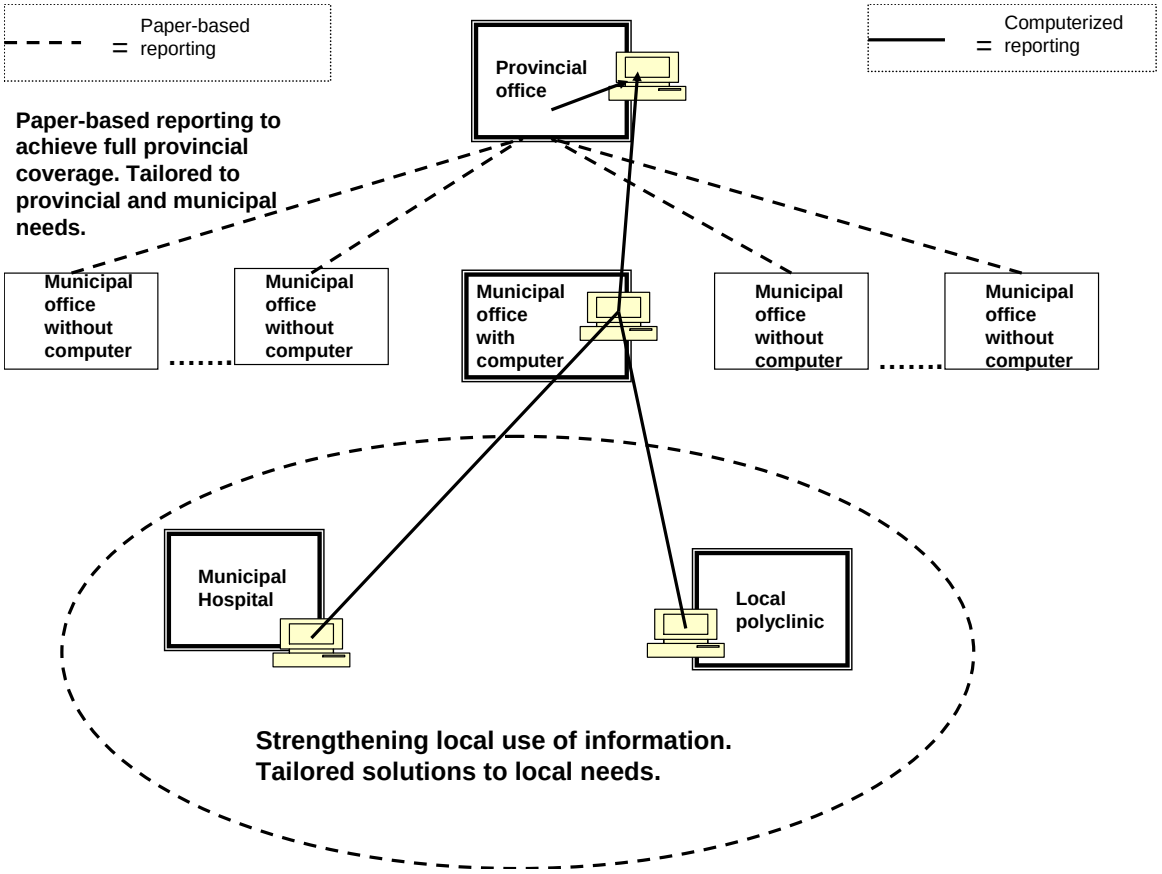


Figure 20. Provincial development approach

7.3 Translation of the graphical user interface

In order to make a Cuban HIS with the help of the DHIS database tool we had to translate the software's graphical user interface (GUI) to Spanish. The database tool supports easy translation to any desired language, and can be run in the desired language by selecting the language in the Windows properties (ref. 7.1.1). All the strings that are used in GUI are organised as numbered strings in an Access database. Each textbox and text field in the GUI has a similar number which the strings are connected to. By adding Spanish strings to the language table in the multilingual database, the software can be run in Spanish. All 2280 strings must be translated in order to get a full Spanish version. In addition, the user manual should be translated to Spanish to provide support to the users.

The translation process is time-consuming, and one of the employees at the DNE spent about two weeks translating all strings from English to Spanish. If more than one person is involved in the translation process, it is extremely important that all translators communicate closely to assure a consequent translation. It is also important to use the national terminology for computer science, as computer terminology is often a bit different from the natural meaning of the word, and often the English word is part of the national terminology and used in the local language as well. As an example, in Cuba

they use the word “mouse” also in Spanish, and not the direct translation that would be “raton”.

Due to time constraints, we started to use the software in a training session at the DNE before all the strings had been translated, and that was not a good experience. English words showing up in a partly translated version is not the best way of promoting a new system.

As experienced in Mozambique when first translating the DHIS from English to Portuguese, text-strings in Latin languages tend to be longer than in English. This is a problem when the Portuguese and Spanish strings are much longer than the English, making the predefined sizes of buttons and text fields in the DHIS GUI too small. While the DHIS GUI had been modified to fit Portuguese text, some buttons were still too small for Spanish.

The GUI is defined in the front-end file (ref. Figure 15) which is installed with the software package, as a result we had to change the sizes manually, which is easy if you know how, at all offices where the DHIS was installed. While these changes were reported to the software developers in South Africa and incorporated in the next release, this is a continuous problem since when new features are added, new strings translated and new buttons must be redesigned. The developers in South Africa partly solved this problem by sending us new text strings to Cuba for translation before the release of a new version, so that this could be countered for before the installation.

Figure 21 and Figure 22 illustrate some of these problems. The grey buttons on the right on both figures show how the Spanish strings demand more space. The third button is resized to fit the longer Spanish string. The eight button from the top is a new feature that has no yet been translated to Spanish, therefore the English name appears on the Spanish version. The yellow text fields on the left show similar problems. The fourth text field from the top is not yet resized to fit the longer Spanish strings and thus the whole text is not displayed in the Spanish version.

Translation of the manual turned out to be a more difficult task than we expected. First, we delayed this work as the South African team was working on a new and better English version of the manual. The old manual was incomplete and partly outdated. In addition we had to finish the translation of the software before starting with the manual in order to use the same terminology and examples with screenshots of the Spanish version. The translation had to be done by someone who knew Spanish, English, was familiar with computer terminology and to some degree knew the software. The translation of the manual was planned finished by a Cuban working in Norway during summer and fall of 2002, but this work was never finished. The people involved in the HISP team with adequate knowledge had too heavy workloads to complete this work, so the manual was still only partly translated when we left Cuba, in December 2002. At the DNE level there are several employees, including the network administrator, who speak English, and who should be able to both use and translate the English version of the manual.

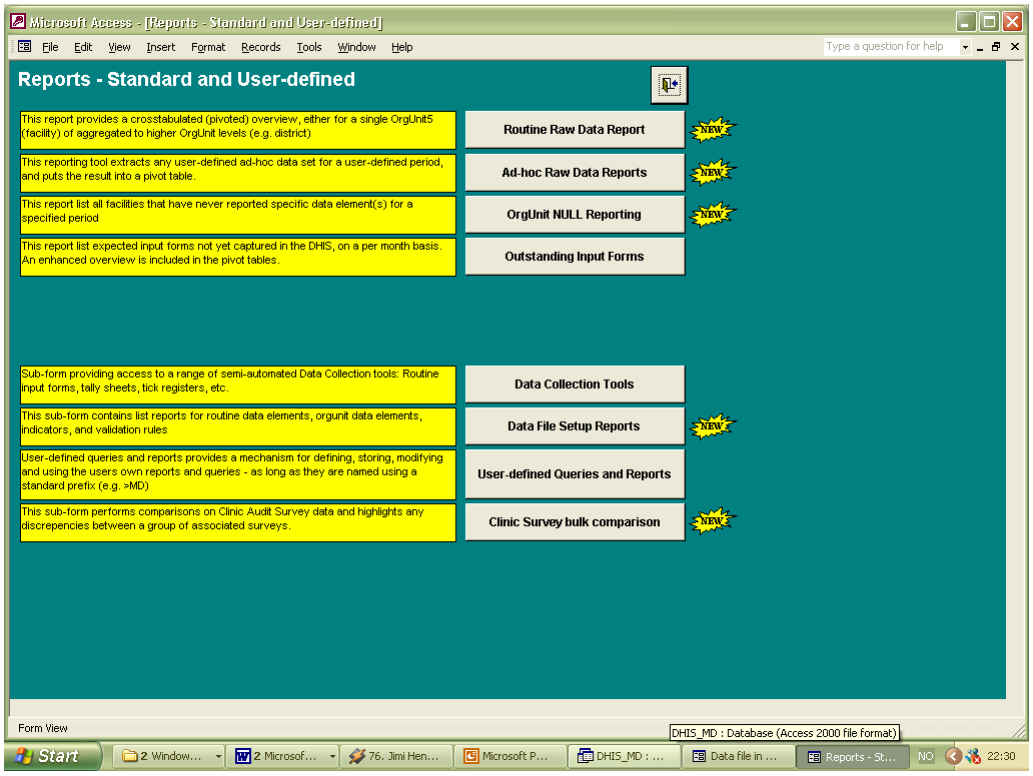


Figure 21. English version of DHIS

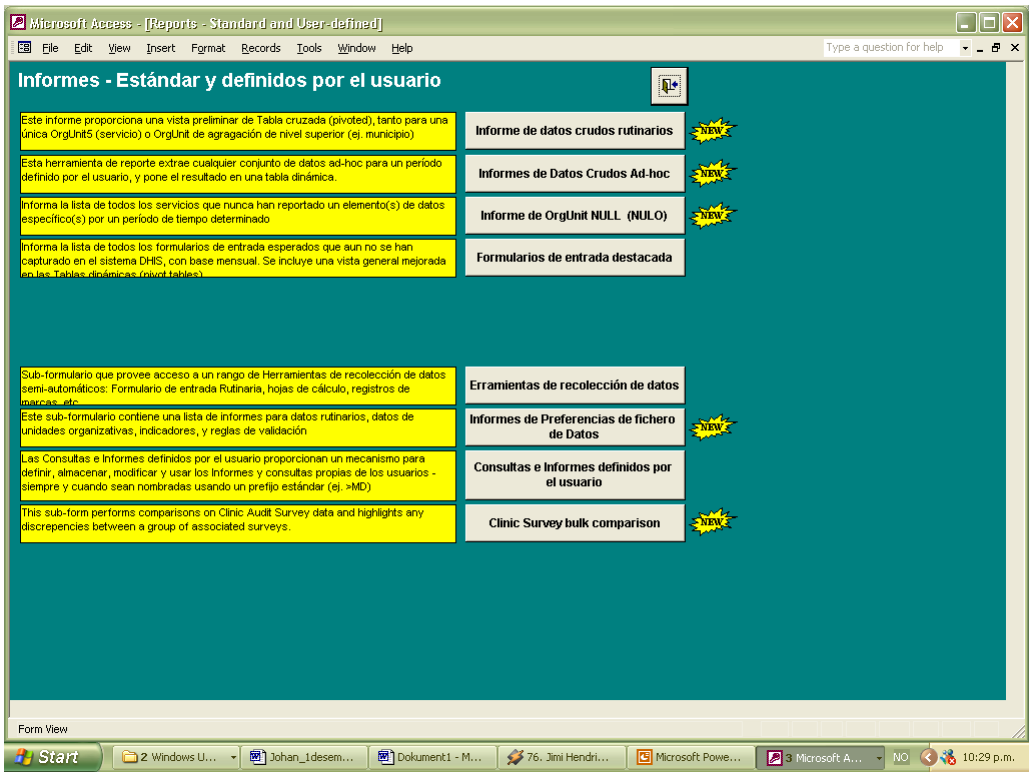


Figure 22. Spanish version of DHIS

A good Spanish manual would have improved the learning process, and been an important factor in achieving a more sustainable and Cuban driven system. When training the local workers in the software we would have saved much work and done

better with a Spanish manual at hand, as few of the local workers spoke English, but unfortunately this translation was not given enough priority.

While working with the Spanish version of the software we discovered some problems related to the multilingual module. The software checks Windows' regional options before it chooses what language to use, and thus to use the Spanish version the location field in the regional options must be set to a Spanish speaking country. However, when changing the location in the regional options, Windows changes much more than just the language. Date formats, numbering standards and a range of operators and separators are set to the standards used at the selected location. The software uses some of these operators and separators and expects the use of U.S. standards, and when different standards were used we experienced problems. These standards can be changed back to U.S. variants manually, but by default Windows uses different standards, following the location set in the regional options. In section 9.2 where we evaluate the software there is a more detailed description of these problems.

7.4 Database design and participation

The design approach used in the development has followed the evolutionary prototyping strategy (ref. 2.1.3) and has been dependent on a mutual learning process (ref. 2.1.3) between the Norwegian consultants and Cuban participants from all levels in the health system. Prior to the development process, the Norwegian systems developers had limited knowledge about the Cuban health information system and its routines and information flows. This local knowledge that has been the basis for the design and adaptation processes, we acquired through an active Cuban participation.

The database tool DHIS (7.1) has facilitated a rapid prototyping of the database system and been outmost useful to us in the development process. Using the DHIS tool to develop a functioning database system, the main task is to represent the local reporting structures, the local datasets and the local routines in the database, as the features for processing, analysing and using the data already are in place. The first steps to get a running database are to develop a dataset and a database structure (ref. 7.1.2).

The process of modelling datasets is basically selecting what data to gather in the database, and finding solutions on how these data can be modelled from the existing paper-based forms into datasets to be used in the database.

Modelling a database structure is the process of building a structure in the database that reflects the reality of the reporting structures. A database structure must contain definitions of health units, administrative levels and the hierarchical relationships between them to model the reality's information flow.

The tool has certain constraints on how the datasets and the database structures can be designed, however when these are followed, the process of actually building the database is a straightforward job. The challenging task is to map the reality of the Cuban reporting structure and its datasets into the specific format that the database tool demands (ref. 7.1.2).

For readability reasons, in this section we will not go in detail on the process of developing these datasets and database structures, instead this detailed description is given in Appendix B. We will focus on how the development methods were put in practice and how we followed the approach and objectives in the design phase. We put a special focus on Cuban participation in the design process, and the importance and challenges related to this task.

The following subsections will be presented:

7.4.1 - The pilot database – a provincial approach with an essential minimum dataset
7.4.2 - Local adaptation and local participation
7.4.3 - Change in approach – a central political decision
7.4.4 - Challenges with Cuban collaboration and participation

7.4.1 The pilot database – a provincial approach with an essential minimum dataset

Just after finishing the work of developing the provincial approach, we started to design the first pilot database. Following an evolutionary prototyping approach with the help of the prototyping tool DHIS it took us about 10 days to quickly design a pilot database at the DNE in June 2002. We wanted to finish the pilot design as soon as possible, and start to test, redesign and adapt it out in the two provinces with participation from the local stakeholders.

The design of the pilot database was directed by two important decisions; 1) the decision to use an essential minimum dataset, and 2) the decision to capture data at the working group and health unit levels.

Based on the research from some short fieldtrips to the two provinces where we visited all levels from the provincial office to the family doctor's office, and on a close participation with key stakeholders at the DNE, we designed the essential minimum dataset and the database structure that made up the first pilot database. This pilot database was targeted at municipal and provincial offices as well as the four local units that were equipped with computers (ref. 7.2). The essential dataset was also to be used in the paper-based reporting system that was part of the provincial approach. This way, the two provincial offices would have full provincial coverage on essential routine health data.

Essential minimum dataset

The essential minimum dataset strategy has proven successful in South Africa and thus supported by the HISP team. As mentioned the present Cuban system is based on a totally different approach concerning data collection, and we had expected a much tougher discussion on using a minimum dataset. However, although the Cubans supported this when deciding on the development approach early in the project, this support changed to scepticism a few months later as we will explain in section 7.4.3.

The pilot database system was targeted at capturing monthly routine health data and the DNE selected four of the most important subsystems of this type of health data from the

present HIS (ref. 5.5.6) to make up the essential dataset. All four subsystems have the same reporting frequency and aggregation level which made it easier to use them in the same dataset. These subsystems follow the same routines and information flows as the *Consultas Externas* subsystem described in section 5.5.7.

To provide both good quality low-level data, and a dataset that is extensive enough for the national level, we had to make an essential dataset with the most important data elements from the selected forms. The four selected subsystems totally contained about 500 data elements and we needed a selection of less than 50. With this in mind, the Cuban project responsible and the Norwegian project coordinator identified an essential minimum dataset of 36 elements selecting the most important elements from the four subprograms, plus a few new elements. As an essential maximum dataset for possible use at a later stage, they selected all data elements from these subprograms. Appendix B provides a more detailed description on how these datasets were designed.

This essential minimum dataset was a national dataset that all reporting units within the scope of the project had to collect. This way we could develop a national database based on this national dataset with working group-data and health-unit data from all the involved pilot municipalities in the two provinces. Based on the logic of the hierarchy of standards that is encapsulated in the DHIS software (ref. 7.1.2) this national dataset will be inherited by all levels in the health system, and in addition each level has the flexibility to add new data elements to this national dataset in tailoring the database to their specific needs. As we will describe in the next section, as part of the process of adapting the database system to local conditions was the participatory design of local datasets with local stakeholders.

Mapping the reporting structure into the database structure

We had to design a database structure to represent the reporting structure that is involved in reporting the essential dataset, and this reporting structure is the same as the one seen in Figure 19. However, the database structure will not include units and levels below the data capturing levels as these units are not involved due to aggregation. So in Figure 19, all levels and units down to the working groups have to be mapped into the database structure.

As mention earlier (ref. 7.1.2), there are some strict rules that have to be followed when designing a DHIS database structure. Following these rules we designed the structure seen in Figure 23 below. Based on the data capturing level we called this database structure *the working group structure*. The working group structure together with the essential minimum dataset made up the first pilot database that was to be implemented in all pilot places in the two provinces. The process of implementing the pilot and adapting it to the local condition is covered in the next section.

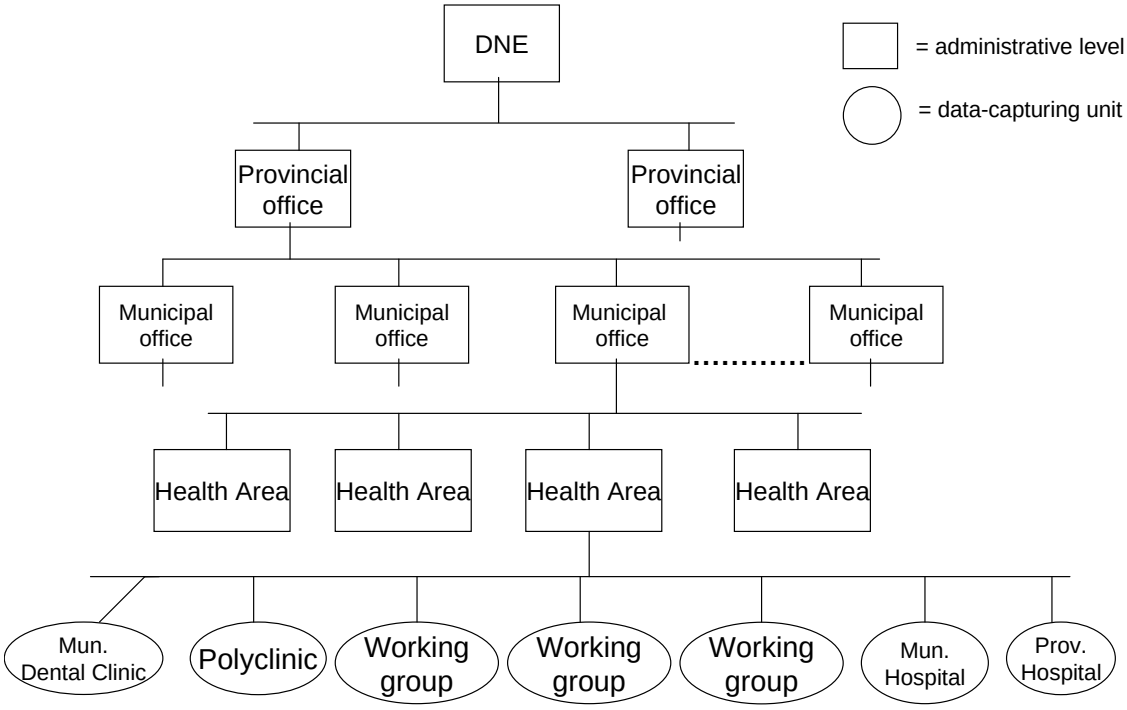


Figure 23. The working group structure June 2002

Explanation: Mun.= municipal, prov.= provincial

7.4.2 Local adaptation and local participation

After designing the pilot database at the DNE we went out to all the pilot places to set up the donated hardware, install the software tool DHIS with the new pilot database, start to train the users, and to get feedback and participation to redesign and adapt the pilot to the local conditions. In all 12 pilot sites we encouraged the local statisticians and health management to participate in improving and adapting the current database prototype. Using the flexibility found in the software tool we designed some additional database solutions that were tailored at special local needs and possibilities.

This local participation in adapting the database builds up a feeling of ownership among the participants to the system that is very important (ref. 2.1.3 and 2.3.1). Local ownership and commitment at different levels and at as many pilot places as possible is the key to develop a sustainable system.

An overview of the pilot places

Below (ref. Figure 24) is an overview of the different pilot places selected by the DNE to participate in the HISP project:

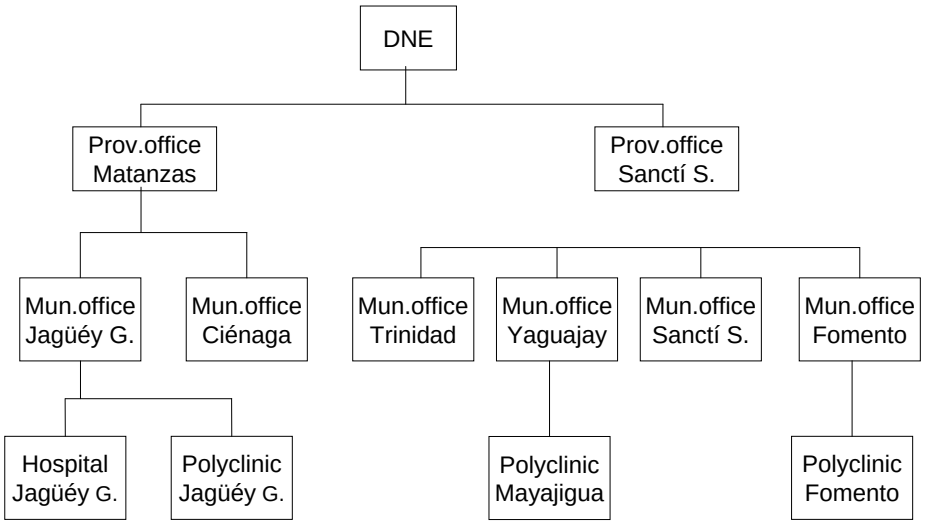


Figure 24. Overview of pilot places

Explanation: Mun. = municipal, Prov. = provincial
Jagüéy G. = Jagüéy Grande, Sanctí S. = Sanctí Spíritus

Prototyping local adaptations

We installed the pilot database with the essential minimum dataset and the working group database structure (ref. Figure 23) at all the pilot places seen in Figure 24. At each place we discussed possible improvements and local adaptations that could help to tailor the local database to the specific needs of each local context. To obtain the needed knowledge to make local adaptations and improvements to the prototype we participated in mutual learning processes that where integrated parts of the local training or database maintenance sessions, learning processes that gave us got much local knowledge about the information flows, working routines and local hierarchical structures. While the users got more familiar with the database system their participation increased as they more clearly saw how we could adapt it to their own needs. Here we will give some examples on how this participatory design process took place.

One example on how we improved the database structure is how we changed the names of the working groups defined in the pilot database to the more correct names used locally. At the DNE at the national level where we designed the pilot database we used national-level information on the hierarchical structure to design the database. In this national information most of the working groups are named by numbers, as working group 1,2,3,4 etc., but locally they use real names. At every municipality we changed the names found in the pilot database structure to the names used locally, which made the system much more user-friendly and locally adapted. As an example there is a health area in Jagüéy Grande that has three working groups, and in the national information at the DNE these groups are called GBT1, GBT2, GBT3 (GBT is the Spanish abbreviation for working group). While working at the local office in Jagüéy

we soon learned that the working groups have the local names *GBT Sur*, *GBT Norte* and *GBT Australia.* When the local statistician in Jagüéy Grande enters monthly data for a working group she has to select the desired group from a list of all the groups in the area, and clearly a list with the locally used names is more user-friendly than working with unfamiliar names from the national definitions.

There is a nationally defined rule in the Cuban health system that says that a working group must have at least 20 family doctor offices, and in some of the municipalities we experienced that this strict rule creates difficulties in data analysis and information use. One of the health areas in Trinidad municipality is a rural mountainous area that has less than 20 family doctors and hence does not have its own working group. Despite that this area has its own polyclinic and local management that administer the app.15 family doctors, its family doctors are grouped together with some 10-15 other doctors from another polyclinic in a different area. The data that the mountainous area reports in the present HIS is added together with the data from the other area's doctors in the same working group to an aggregated total for the working group, and this number is then a mix of the special rural data and data from a much more urban area. The local staff at Trinidad municipality disliked this arrangement and the fact that they could not do analysis on that mountainous area separately. They liked the idea to create extra working group in the database system to cover this rural area, and thus provide locally useful information to do analysis on this rural area. This local flexibility that the database tool provides will not be noticed further up in the health system, as neither the provincial nor the national level do analysis on health areas. The total for the municipality, which is more interesting for the higher levels, will be the same either way.

Following the development approach (7.2) we set up computers in two polyclinics in June 2002, and in addition we installed the system in a third polyclinic that already had a computer. This was an important part of the strategy to improve local analysis and use of information. With a computer located at the polyclinic there are new possibilities considering the data capturing level, and as seen in Figure 19, is possible to capture the data at family doctor level since there are only two levels up to the health area where the polyclinics are situated. The polyclinic staffs were positive when we discussed this option, and they liked the possibility to analyse data disaggregated and kept at the lowest level. Many of the paper-based monthly reports they use within the polyclinics are using the family doctor office-level, so this level seemed very reasonable for data capture. The design challenge was then to build a database solution that allows data capturing at the family doctor level and at the same time is compatible with the provincial database the other units use. Compatibility with the provincial database was crucial since these polyclinics would report data to the municipal offices that were using the provincial database. The strict rules of the software considering the database structures made it impossible to make this polyclinic solution a part of the provincial database, as we could not use the already designed working group structure (ref. Figure 23) for this task. We designed a new database structure, *the polyclinic structure* that supports data capture at the family doctor level and developed a small conversion program functioning as a gateway between the two database structures providing compatibility. In this way the two databases can be considered as one, as the users at the municipality that receives computerised reporting files from the polyclinics, do not notice that the polyclinic uses a different structure, thanks to the conversion program.

We set up a computer in the extremely rural municipality Ciénaga de Zapata in the Matanzas province. This municipality is a vast area with large swamps and a small population spread over a few small villages. The PHC hierarchical structure in this municipality is quite different from a normal structure, as there are 3 health areas and just one working group. Due to the national rule defining working groups mentioned earlier, there are three polyclinics (or similar PHC units) and just 1 working group with 18 family doctor offices. We discussed this structural challenge with the municipal statisticians and found that the best solution for them was to use the polyclinic structure at the municipal office and capture data at the family doctor level. Having the possibilities to compare the 18 family doctors, and also group them in three geographical areas when doing analysis is far much better than doing analysis with only one working group unit in the local database. This local adaptation provided a huge difference in the output of the database system concerning local use of information.

In section 7.2 we explained how we managed to get full data coverage in the Matanzas province despite the difficulties put forward by the DNE. Instead of using paper-based reporting with a low level of aggregation, the working group level, as was the approach in the smaller Sanctí Spíritus province, the municipalities reported the essential dataset with data aggregated to the municipal level. This great initiative to get full provincial coverage was taken by the provincial office in Matanzas. The national level did not want full coverage in Matanzas since it would involve 12 municipalities without computers, and probably as mentioned earlier, this was also due to central control needs (ref. 7.2). The provincial office in Matanzas got all its municipalities to report the essential minimum dataset with municipal aggregates from the past two years, enabling us to build up a comprehensive provincial database useful for training purposes and demonstrations. To support this data capture at the municipal level we designed a new database structure called *the provincial structure* that is not compatible with the pilot database, but outmost useful as a training and demonstration tool when presenting the benefits and the possibilities of the software. A more detailed description on how we designed the provincial database structure is found in Appendix B.

Local adaptation of the essential minimum dataset

In addition to tailoring the database structure to the local pilot sites, an important redesign task was to adapt the essential minimum dataset to local needs. As mentioned, the software provides a flexibility to build local additions to the nationally defined dataset with data that is used for analysis at a specific administrative level or within one specific unit (ref. 7.1.2 and 7.4.1). While working at the different local offices we encouraged the local users to adapt the dataset and add adapt elements that could help to improve local analysis and local use of information. After two months in the provinces the essential minimum dataset had grown from 35 to about 80 data elements, and many of these were only used at the polyclinics and not meant for reporting upwards.

In some polyclinics where we managed to get a fruitful participatory process we discovered that local use of information is quite good and that there exists locally defined routines and reporting forms that support local use of information in an action-led manner. Local forms requested by the polyclinic manager or the chief of the working groups with a selection of the most important local data taken from different national forms are examples of such local initiatives. These forms were called *datos negros*, which is Spanish for black data indicating that these were unofficial routines

and not part of the national information system. Data elements found in these forms were typically the kind of data we wanted to add to the local essential datasets.

In the municipality of Jagüéy Grande we set up a computer in a municipal hospital where we installed the pilot database (ref. 7.4.1). The working group database structure (ref. Figure 23) accepts data entry at health unit level, which among other units includes the municipal hospitals. The essential dataset however is mostly based on PHC data and is not tailored to hospital use. Therefore we worked with the hospital statisticians to add more hospital related data elements to the dataset and define hospital indicators to use in the database. In this way the pilot database became more adapted to the hospital's needs.

The Matanzas province – an overview of local adaptations

To see how the different local adaptations fit together we first present an overview (see Figure 25) of the pilot sites in the Matanzas province illustrating which database structure they use and other local differences.

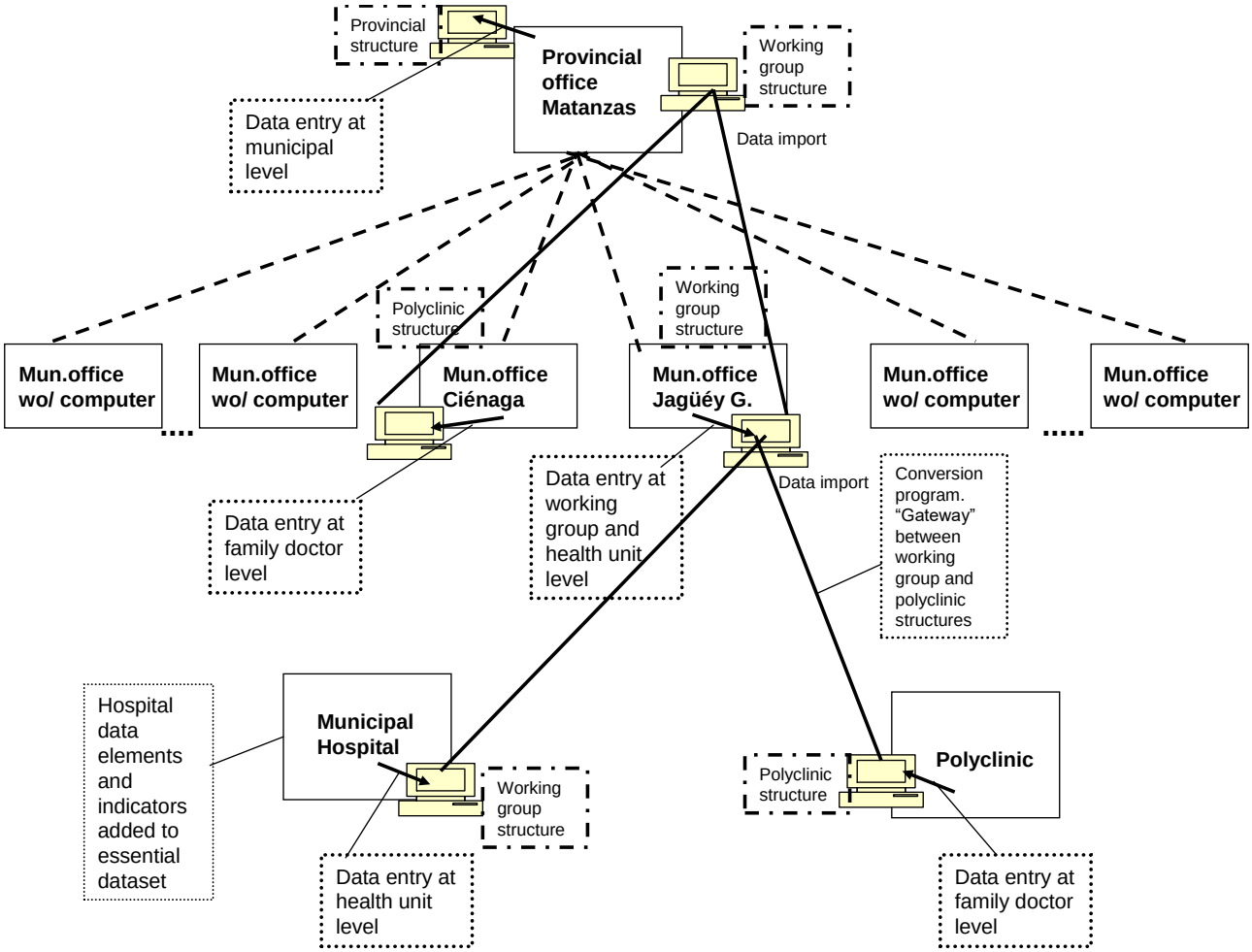


Figure 25. Overview of database approach in the Matanzas province

Explanation: -------- *= paper-based reporting*
_____ *= computerised reporting*

The Sanctí Spíritus province – an overview of local adaptations

In the Sanctí Spíritus province which has only 8 municipalities compared to Matanzas' 14, the DNE opened up for a full provincial coverage using the working group level also in the paper-based reporting from the municipalities without computers. In this way this provincial office has only one database compared to Matanzas where they used two different ones. The paper reports from the 4 municipalities without computers are entered manually into the database using the working group structure. The data from the remaining 4 municipalities that have a computer is automatically imported into the database through an import feature in the software. In this way the provincial office in Sanctí Spíritus has a provincial database with disaggregated data from all its municipalities which was an important goal considering scale.

Two polyclinics in Sanctí Spíritus province are equipped with computers and use the polyclinic structure, the Fomento polyclinic that got one of the donated computers, and the Mayajigua polyclinic in Yaguajay municipality that already had received a computer from another international project.

Figure 26 below gives an overview of the approaches and local adaptations from the Sanctí Spíritus province.

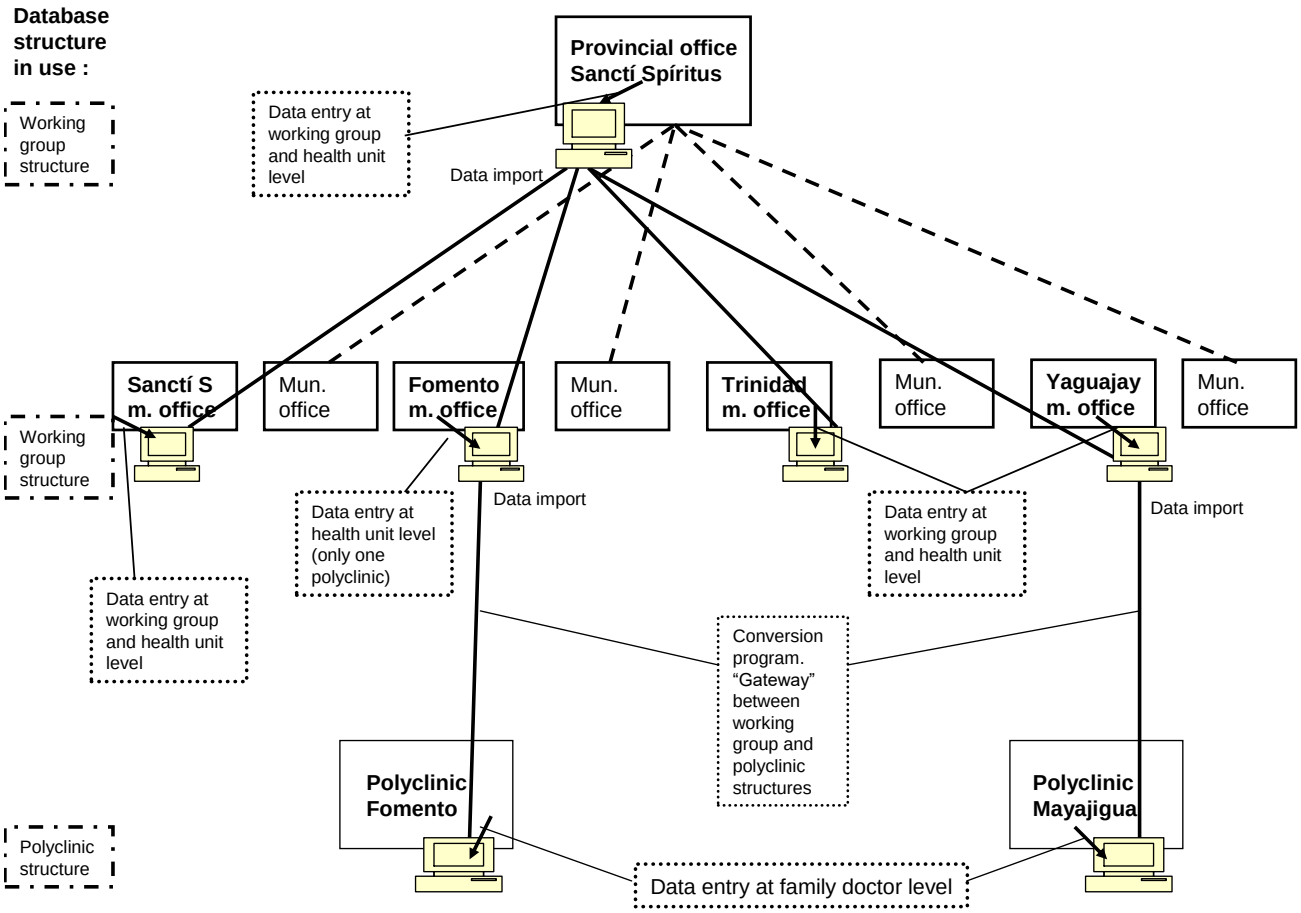


Figure 26. Overview of database approach in the Sanctí Spíritus province

Explanation: -------- *= paper-based reporting*
_____ *= computerised reporting*

7.4.3 Change in approach – a central political decision

The development approach developed in June 2002 (ref. 7.2) was followed during the first period of the fieldwork described above. But in November the DNE decided to stop all actions out in the provinces and go for a quite different approach compared to the one develop in June 2002 and to the objectives in the *terms of reference paper* (ref. 6.1 and Appendix D).

However, already with the administrative change process in MINSAP in July 2002 the political support for the project changed drastically (ref. 6.2). The first signal of reduced political support came when the DNE stopped all paper-based reporting in the Sanctí Spíritus province and thus hampered the plans of a full provincial coverage (Figure 26).

In June 2002, with the DNE management present at the provincial office in Sanctí Spíritus, we decided on using paper-based reporting from the four remaining municipalities that did not have a computer. This was an important decision in achieving a useful provincial database with data from all municipalities. Later, when we were about to implement this approach together with the provincial staff in Sanctí Spíritus, the DNE management phoned Sanctí Spíritus and told them to stop any involvement of the four municipalities that did not have a computer. In fact, he even prohibited us to use old data from these four municipalities that already had been reported to the provincial office. This was a clear sign that the DNE did not want a database system that had full data coverage from all municipalities, meaning a useful and powerful provincial database. The DNE wanted to be in charge of the project, and did not like that the provincial staff got too involved. Instead, the DNE preferred that we only involved a few municipalities within each of the two provinces in a fragmented approach without too much participation from the provincial staff, an approach that would be easier to control from central level.

After two months of fieldwork in the provinces, the DNE started to express scepticism towards our focus on the local level. During the first months we had prioritised to spend much time out in the provinces dynamically designing a system with local participation, using a bottom-up strategy. At a meeting in Havana in November 2002 where the Norwegian project coordinator also was present, the DNE explained that they did not feel in control of the project processes, and that they did not like the fact that local workers had more knowledge about the system than they had. They wanted a much stronger focus on knowledge building at the DNE, and they meant we should postpone further implementation at the lower levels until they had more knowledge at the top level. From the end of November 2002 no more project actions has taken place in the two provinces, and all the promising local development processes have stopped. Instead all development has been done within the DNE office at central level following a much more centralised top-down development approach in stark contrast to the development approach that was followed the first months.

Maximum dataset approach

The idea of having essential minimum datasets might have represented too much of a drastic change to the DNE, because in November 2002, they expressed an interest in using maximum datasets similar to the forms in the present HIS. The essential dataset approach did not fit with the political demands of having a large collection of reports

centrally to support monitoring and control, and the approach focused too much on local needs for information, which was not an important issue to the DNE. The flexible essential minimum dataset approach was too different from the existing paper-based system to be considered as a serious replacement, and was therefore not viewed as a serious approach by the DNE.

As mentioned, the DNE did not feel comfortable with the strong focus on the local level, and wanted to move the development process to the DNE office and focus on national needs for health information.

The essential minimum dataset approach we had used so far in the project used a selection of data elements from different forms adding up to a dataset with important data for an overall analysis. The DNE was now more interested in developing many separate databases, each database completely covering a specific subprogram or form from the paper-based system. Such databases would use what we call maximum datasets, completely covering all data elements from the paper-based counterpart. In practice this means directly copying the paper-based information system into database solutions, including the levels of aggregation.

As we have seen from Figure 18 using maximum datasets forces a higher level of aggregation which again means less useful information for the local level. As we explained in section 5.5.7, the municipal offices calculate and report municipal totals to the provincial office due to the huge amount of data that is collected. Using a database solution with computers at the municipal offices would have to use a similar level of aggregation since entering maximum datasets for all units would demand too much paper and time. The maximum dataset approach with such a high level of aggregation is not supporting local information needs, but this is not an important political objective at the DNE.

At this time, in November 2002, we were expecting a new shipment of about 60 donated computers from Norway, which in some way changed the point of departure for the discussion on data-capturing levels. Equipping more local units like the polyclinics and hospitals with computers, would mean that even a solution with maximum datasets could produce good quality data also for the lower levels. With more units in the municipalities sharing the data entry process, a lower data capturing level is possible. However, to implement a solution like this all over Cuba would demand far too many computers looking at the available resources.

Starting with the new maximum dataset approach, we found out that the subsystem for hospital patient flow, *Movimiento Hospitalario* could be a good pilot database. The hospital hierarchy is quite small compared to the PHC considering both levels and units involved. Another interesting issue considering the hospital system is that the data is captured per unit and not aggregated at a later stage. The DNE uses hospital data at unit-level when analyzing this subprogram at the national level. As we have explained earlier, in most subsystems data is aggregated to municipal and provincial totals. This means that a new hospital database system, with proper use at the provincial level, could provide useful local data for hospital management at each hospital.

The design of the new maximum hospital dataset and the hospital database structure is described in Appendix B.

7.4.4 Challenges with Cuban collaboration and participation

Following a systems development strategy with a strong focus on user participation we have encouraged Cuban health personnel at all levels to take part in the development of the database system. Our development has followed a participatory approach with a need for involving all key stakeholders and to facilitate a mutual learning process between the different users and the developers. Important goals of such an approach are to ensure that the system reflects the practical reality of the users and to provide local ownership to the system (ref. chapter 2).

In section 7.4.2 we gave some examples on how local participation and a local mutual learning process have led to improved database solutions for the local level. Even tough we managed to redesign and improve the prototype to more adapted local databases we still feel that we did not get a collaboration and participatory process that lived up to its full potential during these fieldtrips. In some pilot places, we have had a fruitful collaboration, while in other places that has been extremely difficult to obtain. The most challenging constraint in the participatory design process has been the restricted access to different stakeholders.

Restricted participation

The health statistics department of the Cuban health system has been our working domain. When initiating the project, our understanding was that this department would be a perfect point of departure for developing a HIS. Later, we began to see how fragmented the health system was, and how separated the statistics department was from other sections. This fragmented system and similar fragmented power distribution have more or less limited our working domain to health statistics. We have experienced problems with the participatory process related to this fragmentation and limited inter-departmental collaboration.

The national health statistics office (DNE) has no authority outside the health statistics branch, and considering our project, they are not interested in much collaboration with other sections. They are responsible for all project actions and are not willing to take the risk involving staff outside statistics at any level in the health system hierarchy. As we have described section in 6.2.3, the DNE direction has been under a lot of pressure after the drastic administrative changes in the MINSAP. In danger of loosing their positions they have not been willing to take any risks involving personnel outside his command structure. The feared scenario is as follows: A local health manager who is not within the health statistics branch, reports negatively about the project upwards in a different command structure, and this negative feedback reaches the health minister without passing through the DNE.

In many countries, health management is closely related to health information and the health information system, but in Cuba, these are strongly separated. The health statistics department defines and processes health information in the health system, but they do not use the information. On the other hand, the health managers that use information are not involved in defining the content or flow of the information.

Key properties of the database system we have implemented are the possibility to design local datasets and indicators, and most importantly; keep data local and disaggregated so that they are useful at the local level. As mentioned, a part of the local adaptation process was to develop local datasets, however, a system that allows local data elements that not necessarily have to be reported upwards, was completely new to the statisticians we met. We wanted local participation in the design of such local datasets based on the local needs of information, but struggled to achieve this within the health statistics department.

In this user participatory process of designing local datasets, we were surprised by the fact that many of the health statisticians did not understand the meaning of focusing on disaggregated local data, and what we meant by locally important data. To them important data are data that the level above demands and not necessarily data that is used locally. Furthermore, they are not used to collect data that is to be kept disaggregated and actually used locally. Since the statisticians are not involved in data analysis and information use, most of them did not have the background to help us develop data elements, indicators and working routines that could enhance local use of information and local decision-making.

The real users of information are the local health managers, a group not subordinated under the health statistics branch, hence outside our working domain. These managers are the users that will have the greatest benefits from the new database system, and they should be part of the design and training process. The fact that we were not able to get in contact with the local health managers represented two important obstacles to the development process; firstly, we could not involve the users of information in the process of developing a local database system tailored to local health management needs, and secondly, it was difficult to demonstrate the system to the right people. The first problem we partly solved by looking at the different forms they used locally that were developed by the managers (the *datos negros*, see 7.4.2), so that we could se what information the managers were asking for. This was sometimes problematic since these forms are unofficial and difficult to find at the health statistics offices. The fact that we were not able to demonstrate the system to the local managers slowed down the local development processes seriously, since the local managers, unaware of the benefits, did not push the statisticians to work with the system.

There were some exceptions though, and in the places where we were able to involve the local management we experienced a much more fruitful participatory design process. The pilot sites were we managed to involve the local management typically had a closer cooperation between the health statistics office and the other branches of the health system, and hence a more local use of information. This was found at the lower levels were the different branches were smaller and less independent groups than at the higher levels. E.g. in a polyclinic, all groups had offices in the same hall, while at the national level they were found in different buildings. Still, we did not manage an acceptable participation from the managers in all polyclinics, and there were differences in the degree of autonomy even at the same level. In the sub-cases presented in section 7.7 and Appendix C, we will give some examples of these differences.

In some of the places where we did not manage to establish a participatory process involving the managers, we were given the possibility to demonstrate the system to keep the health managers informed of our work. The reactions we got from local

managers that got a demonstration of the system were positive, and in Trinidad, the municipal manager said, "*This is what I have always been asking for!*" In other places, the local management was completely uninformed of our database system, and their knowledge about our project was limited to the fact that we had donated hardware to the statistics office.

Other users outside statistics that would have been fruitful to include in a participatory process are the different analysis groups for strategic planning that are found at the different health levels. Moreover, considering technical aspects of the system, a cooperation with a group called CEDISAP, specialists in production of health software within the MINSAP would have been excellent participators. The staff at the DNE did not have the knowledge or interest in the more technical aspects of the system, and adding a computer scientist from CEDISAP to the project team, could have speeded up both the development and knowledge transfer processes. However, the DNE administration was not willing to involve these user groups in the project, and told us that our working area was restricted to the health statistics staff.

Centralised control

While working out in the provinces we experienced how the centralised system can influence activities at the lower levels. DNE in Havana was running and supervising the project, but most of the action took place out in the two pilot provinces. While working with statisticians below the national level we noticed a strong sense of authoritarian respect for the DNE management. It was no doubt who was in charge of health statistics and took the important decisions. We noticed some differences on how strong the centralised power was at the different places, as we will come back to in the sub-cases, but in general we can say that there was not much sign of autonomy at the local health offices. We will give some examples on how the national level was controlling the project and how this affected our work at the local level.

When working in the provinces we planned local project actions with the provincial staff and sometimes with the municipal staff as well. The project has been a dynamic process and our working routines and strategies varied form place to place with the local level of understanding of the system and commitment to the project. During the project we have experienced how the national level do not inform key stakeholders at the lower levels about the project progress like important decisions on future actions. The provincial health statistics director in Matanzas has been very collaborative in the project, and he has expressed an interest and understanding of the database system. He has been an absolute key asset in the participatory process in designing and developing the system. This provincial director had big plans on involving more of the municipalities in that province, and on how we could make a good provincial database solution. However, the national level totally ignored him when they shut down all actions in the two provinces. After the decision in November 2002 to change to a more top-down approach and centralised development, it took a long time before he was informed that the DNE were shutting down all project actions in his province. After working close with the DNE for some time it has become clear to us that the national level wants strict control over the project, and that they will not let any lower level come up with initiatives or suggestions on further project progress.

Another example of an extreme centralised decision-making and control is from Sanctí Spíritus, where we discussed with the provincial office how to improve coordination of actions in the different municipalities and how to make the training sessions more effective. The provincial staff suggested that we could arrange a provincial seminar with both managers and health statisticians from the four municipalities that were involved in the project. This way we could involve all participants in a discussion about the system and get a more fruitful debate on how to improve its use. We could also train all statisticians at the same time, and thereby achieve a common understanding of system use, avoiding misunderstandings and different practices within the province. To realise such a seminar, the provincial statistics director had to get the approval of the provincial health director, but as she said, that should be no problem. We were excited about the plans that we felt could speed up the development process in a province where large distances and transport difficulties had made coordination of actions difficult. A week later, we were back in Havana and met a DNE management that was furious about the plans he had heard about from Sanctí Spíritus. To us it had been natural to consider the local health authorities at the pilot sites as our supervisors, but after the incident in Sanctí Spíritus, we were told by the DNE management to go directly to him with any suggestions on local project actions.

The health software group CEDISAP that develops most of the computerised applications used in the Cuban health system, had some interesting comments to the DHIS software that illustrate the need for central control in Cuba. While, as mentioned earlier, cooperation with this group was impossible to establish, we managed to arrange one meeting where we presented the software to senior members of the group. An important strength of the software mentioned in section 7.1, is the flexibility given to the local users to adapt the database to local needs. However, the CEDISAP expressed scepticism to this local flexibility and told us that this could be problematic to implement in Cuba. They said they disliked giving the end users access to local database files and administrator rights that they argued, would lead to corrupt data. Basically, it was not the kind of easy controllable and secure application that they usually developed, and they suggested that we removed this local flexibility.

7.5 Learning and sustainability

Training the users at different levels in the health system has been the most time-consuming process in our project work in Cuba. Due to limited time and human resources invested by the DNE in Havana, we did not have any Cuban trainers in the project. The two authors have been the only trainers in the two pilot provinces, and local-level training sessions have been limited to our two fieldtrips in June-July and September-December 2002. During these fieldtrips, the training sessions were integrated part of visits to local offices that also consisted of actions like design and maintenance of locally adapted databases, as well as gaining more knowledge about the local health information routines. More than a normal training, these sessions were mutual learning processes where we had mutual learning interests and learned from each other.

The following subsections will be presented:

7.5.1 - Training tasks
7.5.2 - Training actions
7.5.3 - Results of the training

7.5.1 Training tasks

Our training tasks were closely related to our implementation objectives:

1st implementation objective:

Build a Cuban pilot database with old data from the last two years from all pilot places

Training task 1:
Train all users in basic system use so that they are able to enter data into the database

2nd implementation objective:

Make a sustainable Cuban-driven system

Training task 2:
Train a small group of provincial/municipal IT personnel in database administration

Training task 3:
Train a Cuban national expert in all issues considering the system

In the start-up process, our first goal was to get a pilot database with data from the two provinces up and running. To achieve this, all users in the 14 pilot sites had to be trained in basic system use and most importantly, be able to enter data into the database. We wanted to build up a pilot database with old data from the last two years, a good way to train users, and important to have when demonstrating system features. When learning from entering and reporting old data, we hoped the new users would gain enough system understanding to continue using the system as part of their monthly reporting routines.

A more long-term goal was to make sure that the system is sustainable and Cuban-driven. Training national and provincial experts and database administrators are key tasks to achieve this. When planning the training actions we knew that another Norwegian master student would take over the project work, so our focus was on the more short-term goal, to train the end-users in basic system use. However, we planned to spend some time on training IT staff when visiting national and provincial offices. An important task during these visits was to get as much participation from the Cuban IT staff as possible in design and maintenance of the databases.

7.5.2 Training actions

Training task 1, train all users in basic system use:

During our two fieldtrips to the provinces, we visited all 14 project-places two or three times each, spending on average on day on each visit. Most of the training sessions were visits to the local offices where we worked on the users' own computer. A typical day at a local office consisted of:

- An informal talk about the local information flow, working routines and organisational structure
- Some problem-solving of technical difficulties with hardware or software
- A discussion on the local database model, hopefully leading to new improvements
- A training session were we focused on training task 1, teaching basic system use

These visits were as useful to us considering gaining local knowledge on health information, as it was to the local workers considering computer and system use. This mutual learning process (ref. 2.1.3) was a critical part of our development method, and the basis for Action Research (section 4.1).

An important training strategy was to let the users be as active as possible in the training, clearly more time-consuming than demonstrating the actions ourselves, but it made it easier for the users to remember what they had learned. Due to poor communication infrastructure and a packed schedule, we were not able to give much support to the users apart from the actual visits to their offices. This made it extremely important that the users remembered the most basic actions and were able to work alone with the system without our help. As mentioned, we did not have a Spanish manual (7.3), which was very unfortunate as a manual could have speeded up the learning process and made it easier for the users to work alone with the system.

Two times, we managed to arrange a more comprehensive training session lasting more than one day. As mentioned in 6.2.4 we did a two weeks training course at the DNE introducing the software to the staff at the national level. That time we still did not have any Cuban data collected, so the demonstration had to be done with South African data. This was not very successful, both due to language problems and since it was much more difficult for the Cubans to relate their work to unfamiliar data than it would have been with a Cuban database. We did a follow-up session at the DNE in December with Cuban data that was much more successful. The second more comprehensive training session we did in November 2002 in the municipality Jagüéy Grande, where we have three pilot offices within a small city. We gathered staff from all three places at a three-day course where we did some repetition from the first visit and also started with more advanced features of the system. Gathering personnel from the municipal office, the municipal hospital and the local area polyclinic was a very good experience. We had many good discussions on how data was collected and used at the different places, and how reporting could be done from the polyclinic and hospital to the municipal office. This helped us to better coordinate system actions and routines within the municipality.

Training task 2, train local database administrators:

We trained provincial database administrators when visiting the provincial offices, where we involved local IT staff as much as possible in the design of database structures and indicators. Close participation in practical work with the database was an effective way to give them a deeper understanding of the system. Occasionally we were

joined by provincial IT staff when visiting and training municipal statisticians. This participation in fieldtrips was productive for both parts; provincial IT staff got some hands-on experience with the system, and we gained much more knowledge about local actions and routines when travelling with them. This provincial IT staff is extremely busy helping all health offices with IT problems, and our training sessions were often interrupted by more critical work that turned up.

7.5.3 Results of the training

Implementation objective 1, build a Cuban pilot database with old data:

During our two fieldtrips to the provinces in 2002, we managed to get most of the places to enter old data into the database, which was our primary goal. Still, we feel that we did not have enough time to go trough with all the planned training tasks. We would have preferred more time to explain the use of the system and go into more details on the local benefits the new system presents. In a few places, they have really understood how the system can improve data analysis, but most pilot sites look at the new system as nothing more than a new and more modern way of reporting data upwards. A better understanding of the benefits would help motivating local users to work harder with the system.

Implementation objective 2, make a sustainable Cuban-driven system:

The provincial IT staff has good knowledge of the system, but they are not yet fully mastering database administration and maintenance. More importantly, they have understood many of the advantages of the new system, and have been good ambassadors for the system when visiting the municipalities. The last two weeks of our stay in Cuba, we worked at the national office (DNE) in Havana and during this period, we did some training of the IT administrator at the DNE. Pål de Vibe continued this job from February-July 2003, and the IT administrator is now a very skilled man in all aspects of the database tool.

It is hard to know if the training was adequate regarding sustainability. Since the Cuban HISP project is shut down, and staff at all levels have been given the message to not use the DHIS, it is impossible to measure if the knowledge level about the system is high enough to ensure sustainability.

7.6 Infrastructural challenges

It is hard to categorise Cuba as a typical developing country, especially considering human resources that compare to most developed countries. However, looking at infrastructural issues like transport, electricity, and telecommunications Cuba qualifies as a developing country. In our project work we have encountered infrastructure-related problems with transport, electricity blackouts, voltage peeks, poor telephone lines, and network connectivity. In this section, we will address these problems related to a poor Cuban infrastructure.

7.6.1 Transport difficulties

Cuba is suffering a severe fuel crisis, not being able to import oil from Venezuela for many months. This results in a public transport crisis and a strict rationing on petrol to official transport missions. The MINSAP has to cut down on most transportation within public health, and every week there is a meeting in the ministry where they give out next week's petrol rations to the most prioritised missions.

When planning local provincial activities with the provincial offices, the transport around the provinces was always the most discussed issue. The provincial office was responsible for transport within the province, and they worked hard to support our demanding schedule. We had to be flexible when planning municipal visits and always consider the possibilities of transport before we could do a more detailed scheduling of the project work. Sometimes we were stuck in a city without transport, and had no choice but to reschedule and find alternative solutions. An important lesson has been that there is no use for a strict schedule in Cuba, since this is impossible to follow. Much more important it is to have some overall goals to go by, and to be flexible in the way we mange to accomplish them.

All over Cuba, at all levels in public health we experienced problems with petrol, and as mentioned this resulted in change of plans and ad-hoc solutions. It was also very difficult to gather people from different locations to meetings, making coordination difficult. When we were working in Havana the last three weeks of our stay, we wanted the provincial IT staff from both provinces to come to Havana to continue an important training process. The national director supported this idea, but it was impossible to arrange transport from the provinces. Pål de Vibe has experienced the same during his stay, and he has reported that he was prevented from going more to the provinces due to lack of petrol.

An important part of the knowledge transfer process is that national and provincial staff can follow us around to the pilot places and get some real experiences using the system, but this has been extremely difficult to achieve since they are not able to acquire petrol for such trips. The DNE management also told us that the yearly visit of the MINSAP delegation to all provinces was cancelled in 2002 due to the petrol crisis. We have tried to arrange so that we can have a Cuban bank account pinpointed HISP transport in Cuba, so that the Norwegian side can finance transport, but these plans have stranded in the bureaucratic jungle.

7.6.2 Technical problems

Working in Cuba, we experienced many technical problems that can occur due to the trade embargo, a poor electricity infrastructure, or by a different electricity standard than the European.

We have already mentioned how the trade embargo also affects computer software, and that the UiO, following U.S export regulations, refused to let us install Microsoft products with university licenses on the project computers. Another problem caused by the embargo is how difficult it is to get hold of accessories like printer cartridges and laptop chargers. There is a black market of cartridges because of the high prices and limited stocks in the official shops in Cuba. In the streets of Havana, we were offered

several types of cartridges at half of the official price. As part of the donated equipment the Norwegian side bought 12 printers in Norway, which all use replaceable cartridges and require 220v. The Cubans use old noisy matrix printers with refill options, which is the only solution that works. A future choice must be to buy refill printers to avoid the problem with the cartridges.

The electrical standard used in Cuba is different from the Norwegian, both in voltage and wall outlets. This created some problems for us since most of the equipment was donated by Norwegian organisations. An optimal solution would be to buy the equipment in Cuba, but considering the amount of computers needed, the economical framework made donations the only choice. We had to change all the plugs for power supply to fit the Cuban wall outlets, and this was a lot of extra work. Most of the computers had a 110/220 voltage switch that made them easily usable with the Cuban 110v standard, but some had only the 220v option. The printers we bought in Norway also demanded 220v, so to solve this problem the Cubans set up additional 220v outlets where needed.

The poor electrical infrastructure with voltage peeks and frequent power failures make the computers vulnerable. Of the 11 initial computers, three have damaged power supplies due to voltage peeks, and there is an urgent need for UPSs and voltage protectors. UPSs give an extra backup-time when power failures occur, and give the users time to save their work and shut down the computers properly, and the voltage protectors can prevent damages caused by voltage peeks. As an example, we can mention the problem we had with our laptop charger. During a stay in Yaguajay, a village that suffers frequent power failures, our laptop charger burned down when the electricity came back again with an extreme voltage peek. We spent a whole day looking for a new laptop charger in Havana, but without luck. We could not get hold of a Hewlett Packard or a universal laptop charger, and had to use an ad-hoc solution adjusting a Dell charger that we had.

The telecommunications infrastructure in Cuba is poor, but in a few prioritised places almost at western standards. While many rural places have problems to get modem connections due to poor and unstable telephone lines, Varadero, the tourist centre has fibre optical lines for high-speed communication. Only a few cities have digital telephone lines, and if there is a digital plant in the city, there are just a few prioritised offices that are connected digitally. We had serious problems to get the modems to communicate with the old and unstable telephone lines and in some of the pilot sites, we did not get the modems to function.

The provincial office in Matanzas, which is one of the most modernised offices, has a computer room with an internal network. The main connection of the local network to the internet and medical intranet Infomed is through one single modem connection. The modem uses the only phone line in the whole office, competing with app. 20 telephones and users. The provincial director told us that they had applied for an additional phone line to use only with the modem, but this was still to be approved. We spent about 10 days in that office and every day there was a constant battle for the phone line.

7.7 Sub-case studies

In this section we present the sub-cases from the 13 offices that were involved in the project. A detailed description of each of the sub-cases is given in Appendix C, and here we will just sum up the findings and focus one some of the general lessons from the sub-cases. The main focus of the descriptions is on the participatory processes, and to compare for the level of participation from all places.

General context related findings are summarised in *Table 6* below, and some of these findings, like technical problems and human resources have already been discussed in the previous sections.

Place	Level	Human Resources	Technical Problems	Understanding of system possibilities	Comp uter skills	Level of system use
Havana	National	Good	Some, old machines	Apparently little	Very good	None
Sanctí Spíritus Provincial Off.	Provincial	Good	Few, some power cuts	Good, wanted to expand	Good	Some
Sanctí Spíritus Municipal Off.	Municipal	Good	Power cuts Modem	Good	Good	High
Fomento Municipal Off.	Municipal	Ok	Machine breakdown Modem	Some	Ok	None,
Fomento Polyclinic	Health unit	Ok	Modem	Little	Ok	Ok
Trinidad Municipal Off.	Municipal	Good	Few	Good	Good	High
Yaguajay Municipal Off.	Municipal	Ok	Power cuts Modem, 220 Voltage	Some	Ok	High
Mayajigua Polyclinic	Health unit	Very good	Modem, lack of memory	Very good	Very good	Very high
Matanzas Provincial Off.	Provincial	Very good	Few, some power cuts	Good, wanted to expand	Very good	Very high
Jagüéy Grande Municipal Off.	Municipal	Ok	Modem, machine breakdown	Little	Ok	Ok
Jagüéy Grande Polyclinic	Health unit	Ok	Modem	Little	Little	Ok
Jagüéy Grande Hospital	Health unit	Ok	Modem	Little	Little	Ok
Ciénaga Municipal Off.	Municipal	Ok	Modem, had to install 220 Voltage	Some	Some	Ok

Table 6. General overview of the sub-cases

Participation in the pilot offices

As our methods were based on involving local users in the development, the focus in the sub-case descriptions will be on the level of participation. This level of participation varying from passive receivers to active co-operators was a main factor in the mutual learning and systems development processes.

We have divided the users into three groups:

- Health statisticians
- IT staff
- Health management

Table 7 give an overview of the participation in the different pilot places.

Sub-case	Health Statisticians	Local IT staff	Health Management*
National Office of Statistics, Havana	Ok	Some	Only the management of statistics
Sanctí Spíritus Provincial Office	Good	Ok	Some, presented at meeting
Sanctí Spíritus Municipal Office	Very good	Good	Some, presented
Fomento Municipal Office	Ok	Ok	Minimal
Fomento Polyclinic	Good	Ok, computer group for Fomento	Minimal
Trinidad Municipal Office	Some discussion	Some	Some, presented
Yaguajay Municipal Office	Ok	Some	Good
Mayajigua Polyclinic	Good discussions	Statistics and IT together. UN project.	Good, interested
Matanzas Provincial Office	OK	Very good	Minimal
Jagüéy Grande Municipal Office	Some	None	Minimal
Jagüéy Grande Polyclinic	Little, training	None	Minimal
Jagüéy Grande Hospital	Ok, new elements	None	Minimal
Ciénaga de Zapata Municipal Office	Some discussions	None	Some, presented

Table 7. Participation in sub-cases

** DHIS with local database has been presented to some managers, who showed various interest.*

Here is a short description of the user groups and an explanation on how we rated the participation:

The health statisticians are information producers, in regard to entering data and making reports for the management. This group is the daily users of the system, and the group we had most collaboration with. Since we always worked with the statisticians, we have measured their participation based on to what degree we would interact in discussion about system questions and their interest in learning about and cooperate in the development process. The most passive health statisticians would be recipients of information about the system, however unable or unwilling to contribute in discussions or even question the use of it. Active health statisticians, on the other hand, would

propose new data elements they missed in the database, come up with design suggestions, ask about new functionality, and help clarify issues unclear to us.

The local IT staff is usually the person responsible for maintaining the computers at the offices or the person with the most knowledge about computers. In some of the offices where they did not have computers prior to the project, the IT person is one of the statisticians. Some municipal offices and all provincial offices had skilled people responsible for the computers. At national level we think of IT staff as CEDISAP, the health software developers in the ministry of health, and other comparable groups. The participation of local IT staff is important to get input on technical issues and to get someone familiar with computers to follow up the system. Few people have any computer skills, and a person familiar with installation, updating, hardware, and trouble shooting is necessary at each site. While this is unfeasible at all offices, there is usually someone in the same town, working at a school or a hospital. Good participation is ensured when people join in discussions about the technical solutions on the databases. At higher levels we expected more participation than at the health units, as setting up the databases, adding functionality and programming.

The health managements are the information consumers. This group covers all health management from the Health Minister to municipal directors, directors of health units, and leaders of working groups. The strategic planning department is also included in this group. Participation of all groups is important to develop a good and fair system, but equally important is the feeling of ownership people get to the system. All user groups should be included in the development process, but as we have described in section 7.4.4, and will discuss further in chapter 0, there are various reasons that make this a complex task in Cuba. The health management group consists of people in other health departments than statistics. They did not normally participate in the training sessions for the statisticians. Active managers would be interested in how the data could be presented in meaningful ways, how it could be used to take decisions, and sometimes be eager to expand the project to get more of their municipality or province covered with computers and the system. Health management should participate in defining their information needs and requirements. At almost all offices we presented the system, often with local data, to the managers, but most of the time it was hard to organise meetings and a more cooperative process with any of the information consumers.

Important findings on local participation

We experienced good participation with the statisticians in all sub-cases. They were eager to propose improvements with the first essential dataset and the way the organisational hierarchy was implemented in the database. The extent of participation with IT professionals was lower, except in Matanzas provincial office and where the statisticians for some reason had good understanding of computers and adequate experience. Management was hard to meet. In general it was hard to get any interaction with other departments than the statistics. We tried several times to see local management, strategy groups, and IT departments. But from the very start this was difficult, and later DNE restricted such meetings to a minimum (7.4.4). The reasons for this difficulty will be further discussed in chapter 9. It tends to be easier to meet other departments the farther we come from Havana. It was easier to involve management in Yaguajay and Mayajigua than in Jagüéy Grande, which is easy accessible from Havana. The director of DNE was in Jagüéy Grande several times, but never followed us to any

of the municipalities in Sanctí Spíritus. Also in Trinidad and the municipality of Sanctí Spíritus we met the management, who were eager to learn about the project and the possibilities of the software. After some effort we also had a meeting with the provincial director of health in Sanctí Spíritus. On overall the management is interested in participating in the project, but not encouraged, or even told not to do so.

But even if not told by DNE to restrict the interaction with other departments, people did not automatically think that it would be useful to include others. Even if many managers expressed that the system we demonstrated to them was fine and what they needed, they did not usually take initiative to work with it.

An important finding from some of the sub-cases is the use of *datos negro*s, black data, the unofficial locally defined reporting forms (ref. 7.4.2).This practise is not encouraged by the current system with its vertical information system and little support for local informed decision making. We were told at the DNE that local staff did not have the power or knowledge to define data that are important at the local level. This could be true for most statisticians, just employed to manually aggregate data and report it upwards, but the finding of such locally defined reporting forms at the polyclinics in Fomento and Mayajigua proves there is some local use of data despite the intentions of the current information system.

7.8 Summary of Cuban HIS development

The development process started with a broad political support in the MINSAP and at the DNE and a development approach aiming at full provincial coverage and improved local analysis and local use of information was made.

This approach was implemented out in the two provinces by the Norwegian consultants with local Cuban participation. The local development process consisted of adapting the database to local needs and tailor local solutions. Training and local knowledge building was another important task. The Cuban participation varied from place to place and often we struggled to meet the right users due to the fragmented health system.

This local development process lasted about three months before the central level decided that the local actions had to be stopped and the focus shifted towards a centralised approach quite far from the original approach and the objectives we had agreed on. A political change in the MINSAP early in the project had impact on the development approach and was clearly unlucky for us.

8 Potential benefits of implementing the new HIS in Cuba

In this section we analyse and present our health data. It is not an analysis of the Cuban health system, as we do not have the data or skills for such a task. Neither is it an analysis of information use in Cuba. This we have seen is focused on monitoring the health situation from the central level (ref.). We will present the benefits of using a computerised HIS compared to the present routines, and how the DHIS can be used at each level. Since the municipality is the best unit where health services delivery is managed, we will focus on what DHIS can do at that level.

All data analysis here can be done with Excel, which is today also used in the health statistics in Cuba, however mostly with static spreadsheets rather than the dynamic database-linked pivot tables DHIS facilitates. DHIS provides a more secure and reliable system, saves work, and enables easy analysis and viewing of data. Contrary to the system today, every level can see data for units all the way down to working groups. This is particularly interesting for the municipal health management.

The following sections will be presented:

8.1 - Quality and quantity of our data
8.2 - Benefits of a computerized database system
8.3 - DHIS and the Municipality
8.4 - Data quality
8.5 - Summary of analysis of potential benefits with DHIS in Cuba

8.1 Quality and quantity of our data

The analysis is based on data collected during the project, from June to November 2002. We collected data in three different database structures; the working group structure emphasizing on gathering data at unit level for the municipality, the polyclinic structure gathering data for each family doctor for polyclinic use, and the provincial structure for Matanzas made to compare all the municipalities in the province (7.4.2) The data for the hospital structure, mapped from the hospital system in use at national and provincial level, was imported by Pål de Vibe during spring 2003.

The municipality structure is the first we made, and the one with the most data gathered at local level. Data from all pilot sites is in this database, both for 2001 and up to our departure in the late 2002. However, the amount of data from each site is varying. All data collection was stopped during summer 2002, and there were central orders to not use time on this. Data was often not entered while we were not there, even if there was an agreement to do this. Sometimes data elements where interpreted different from one

office to another. This had to be fixed, so data had to be scrapped or modified. Machine breakdown have further limited some data entering (7.7 and Appendix C). Municipalities with good data are Yaguajay and Sanctí Spíritus. Jagüéy Grande has good data for the polyclinic and working groups for 2002, while the hospital has data from 2001.

The polyclinic structure was made for the polyclinics to do analysis on the family doctor level. The data collected has been aggregated to working groups and imported into the municipality structure.

The provincial database is the most complete of the databases, containing both the essential dataset and populations from all municipalities in Matanzas. The staff at the provincial office entered the data themselves, after requesting it on paper from the municipalities. This database was made to fully cover the municipalities for the province, as outlined in (7.4.2). We have data for both 2001 and until September 2002 for Matanzas province.

Moviemiento Hospitalario is the only complete Cuban information subsystem mapped into a DHIS database and populated with data. This hospital structure was finished by Pål de Vibe after we had left.

8.2 Benefits of a computerised database system

There are many benefits of just getting the Cuban HIS computerised. Today it is mostly paper based up to provincial level. Among the drawbacks of such a system are:

- high level of aggregation
- tedious data processing for analysis and calculating indicators
- manual data processing at each level
- human validation
- paper-consuming
- rigid de-aggregation possibilities

With a computerised HIS, data can be entered once, and then exported electronically between geographical distances and hierarchical levels. Data are stored on the entry level, but can be aggregated for health areas, municipalities, provinces or for the country on reports or in excel pivot tables. The database can hold many periods of data at the same time. The *Movimiento Hospitalario* as it is in the FoxPro database only holds one quarter of a year, and so it is impossible to compare two periods with each other in an easy way.

A computerised HIS makes the system more secure and error free. If data is entered right the first time, it will not change on the way up to national level. Human errors when reading, aggregating and writing numbers will be eliminated. DHIS provides the ability to make calculated elements. These elements are made up of other, and are usually totals of a group of elements. Instead of having to calculate these manually, DHIS does it automatically, thereby reducing the number of elements that have to be

entered and that is subject to human errors. DHIS also has validation rules to make the entering as secure as possible. Each element will have a certain range at each data-entering unit. All entries outside this range will trigger an alert and ask the user to change the entry, change the range, or give a comment. The primary reason is to capture outliers, those data lower or higher than the normal range, so that those can be commented in a reasonable way. An example is of this can be a low number of vaccinations due to vaccines out of stock. But is also serves as a first validation rule to catch typing errors, e.g. an extra digit at the end of a number. When data entering is finished, the user is advised to run the validation rules. These rules exist in the Cuban information system also, but they must be checked manually up to provincial level. Validations are typically of a logic nature. There is support for both Absolute validation rules and Expert validation rules. Absolute rules apply when one value cannot be higher than another. These rules will show if data is wrong. A couple of examples of such validations are;

- Number of *fully immunised before age 1* can not be higher than the number of *children under 1 year.*
- Number of *Medical consultations* can not be higher than *Total consultations*.

Expert rules check the correlation between elements, like incidents of diarrhea among children should be under a certain proportion of the population under 5 years. As the population increases, the figures are expected to increase too. Expert rules are not only used to detect errors, but can be used to for example detect critical correlations in large datasets.

Figure 27 shows an example that would be caught by good validations. The indicator *Consultas < 15 por 10.00* shows total consultations per 10.000 inhabitants under 15 years of age. The provincial office of Matanzas collected the data element *Consultas < 15 años* from all its municipalities to enter in the provincial database. We did not react to the numbers when entering them, since ranges and validations had not yet been defined.

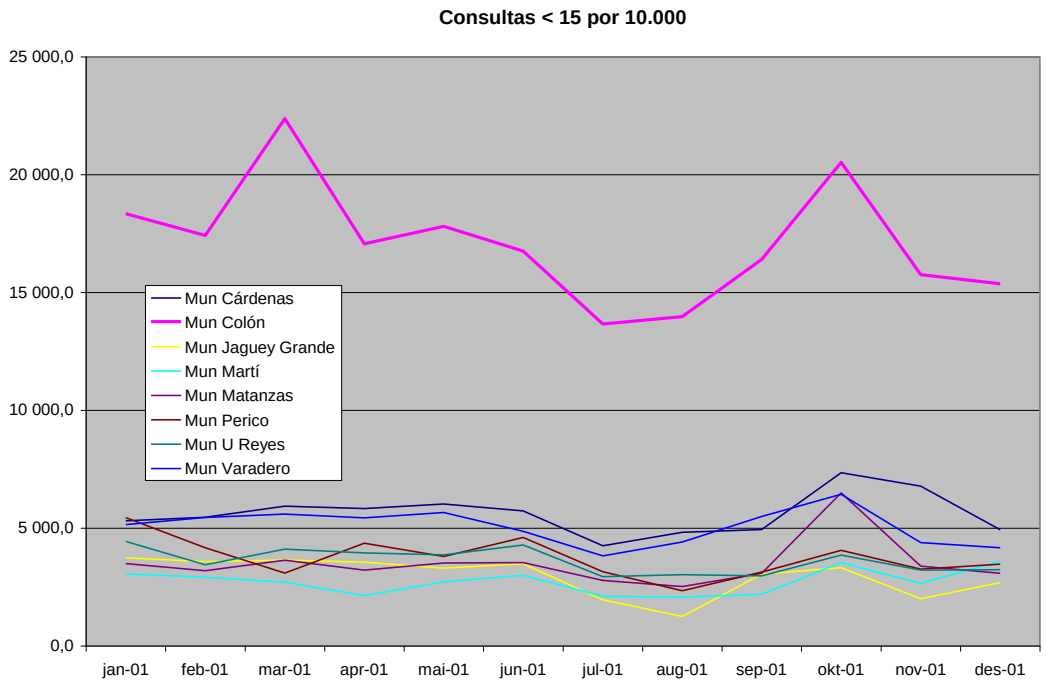


Figure 27. Consultations per 10.000 under 15 years of age in Matanzas Province

The data from municipality Colón is 4 times higher than from the other municipalities (for the two other age groups this element is collected for, Colón has normal values). The graph also shows the power of graphical presentation of data, a well developed feature of DHIS. One can easily spot outliers and strange values. Note that the Cuban summer vacation among health workers is reflected by lower consultancies in July and August.

The current system is incredible paper-consuming. In a country with few resources, this is a big problem and a high expense for the health system. In addition to the costs, there are difficulties obtaining paper. As shown in Figure 6 in section 5.3.2, Cubans are inventive in recycling paper. Since data all the way from the first year of the revolution is stored, paper also takes a lot of space. In regards of the media in which data is stored, computerizing the information system would save money, time and space compared to paper.

8.2.1 Analysis tools in DHIS

The DHIS facilitates easy use of indicators. Data collected in HISs are so called raw data, e.g. how many occurrences of a specific disease in a specific polyclinic in a specific month. To get more useful information out of the raw data there is a need to analyse them, e.g. with the help of indicators:

"Goals or objectives play an essential part in the information of rationales for implementing health policies, programmes and services. Indicators are the basic tools for monitoring progress towards these goals. They reflect the current understanding of the achievements and the future directions programmes should take. Monitoring progress is essentially a process of comparison of indicators, over time and across populations." (WHO on indicators)

An indicator consist a numerator and a denominator, and an example is shown in Table 8. The indicator *Consultations per 10.000 inhabitants* is made up of two data elements, *Number of consultations* and *Population.* The indicator then shows the correlation between the two elements, and in this case shows that even if District B has fewer consultations, compared to the population it has twice as many as District A. We can say that the use of indicators turn data into information.

	Raw data:		**Indicator:**
District	Num. of consultations	Population	Cons./10000 inhab.
District A	150000	100000	150
District B	30000	10000	300

Table 8. Raw data and indicators

Explanation: population data (grouped by age groups and gender), number of beds, or number of staff, are examples of data that can be used as denominator data in indicators to give the raw data more meaning.

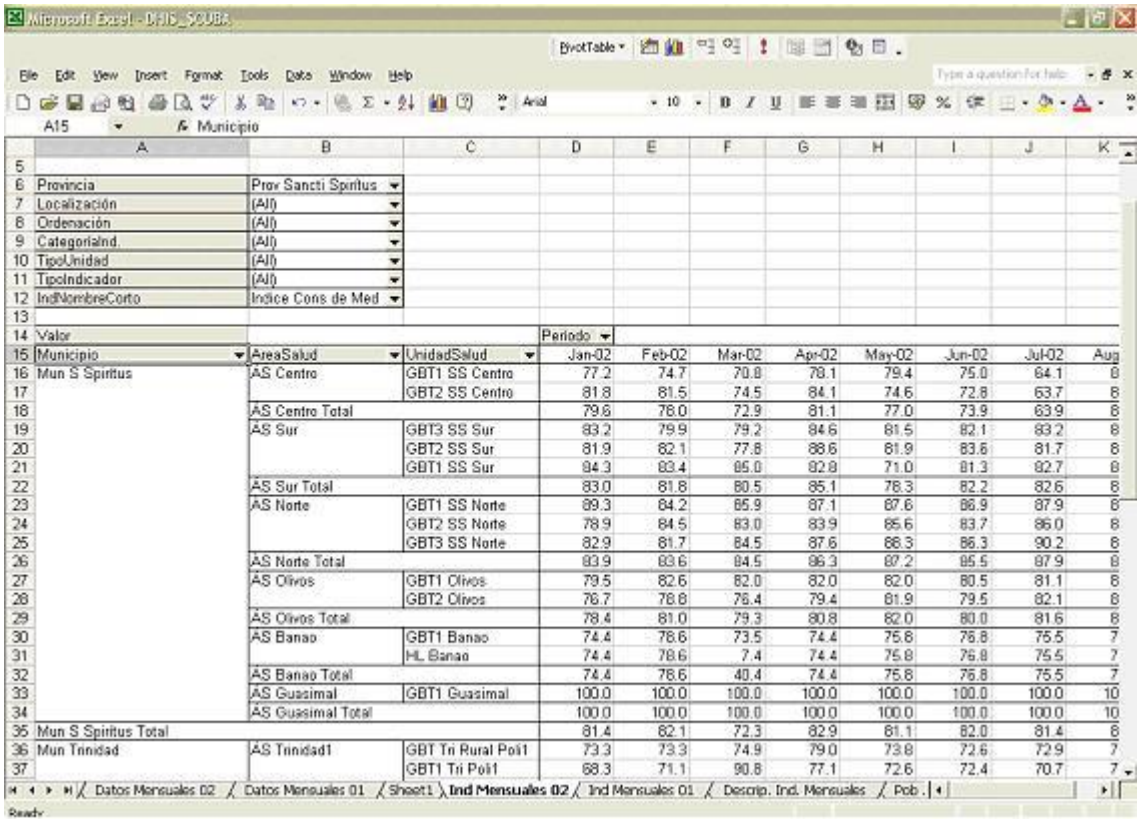
Indicators need to be objective, valid, reliable and sensitive, and all health workers should be able to calculate routine indicators so that the essential activity and knowledge are distributed and not just in the hands of a few selected (Heywood, Campbell and Awunyo-Akaba 1994). Indicators can be defined at all levels in the health system, according to the hierarchy of standards in section 3.2.

The most important feature with the DHIS is the possibility to "drill down" in the levels to obtain data. This applies to all levels. Today there are no easy possibilities to watch municipality level data at national level, health area data at provincial level, or working group data at municipal level. The drawback of this is that information is lost when data is aggregated. Big variations at local levels get insignificant higher up in the hierarchy (Opit 1987). By de-aggregating[4] data in the DHIS, these variations can be found and measures can be taken. The pivot tables offer disaggregated data, which can then be illustrated with graphs. The DHIS thus offers three important "features" for analysis:

- Using indicators, combining raw data
- Drill down or aggregate to desired level using pivot tables
- Illustrate data with graphs, directly from the pivot tables

An example of such use of data can be found in the data from Sanctí Spíritus municipality. Many municipalities do not have the data for the working groups, just aggregated on the health areas. The health areas for Sanctí Spíritus are shown in the pivot table in Figure 28. The pivot table facilitates disaggregated data, with easy aggregated subtotals and totals if desired. The health areas have quite similar values for the indicator *Indice Consultas de Medicina*, the amount of consultancies which are of a medical nature (among all consultancies). However, the health area of Banao shows a drop to almost half the normal level in March, easy seen when applied to a graph, as in Figure 29.

[4] Data is actually not de-aggregated, but less aggregated. Data is stored on its most fragmented form, as it was entered. All other versions of the data are temporarily aggregated as the software is running.



	A	B	C	D	E	F	G	H	I	J	K
5											
6	Provincia	Prov Sancti Spiritus									
7	Localización	(All)									
8	Ordenación	(All)									
9	CategoriaInd.	(All)									
10	TipoUnidad	(All)									
11	TipoIndicador	(All)									
12	IndNombreCorto	Indice Cons de Med									
13											
14	Valor			Periodo							
15	Municipio	AreaSalud	UnidadSalud	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug
16	Mun S Spiritus	AS Centro	GBT1 SS Centro	77.2	74.7	70.8	78.1	79.4	75.0	64.1	8
17			GBT2 SS Centro	81.8	81.5	74.5	84.1	74.6	72.8	63.7	8
18		AS Centro Total		79.6	78.0	72.9	81.1	77.0	73.9	63.9	8
19		AS Sur	GBT3 SS Sur	83.2	79.9	79.2	84.6	81.5	82.1	83.2	8
20			GBT2 SS Sur	81.9	82.1	77.8	88.6	81.9	83.6	81.7	8
21			GBT1 SS Sur	84.3	83.4	85.0	82.8	71.0	81.3	82.7	8
22		AS Sur Total		83.0	81.8	80.5	85.1	76.3	82.2	82.6	8
23		AS Norte	GBT1 SS Norte	89.3	84.2	85.9	87.1	87.6	86.9	87.9	8
24			GBT2 SS Norte	78.9	84.5	83.0	83.9	85.6	83.7	86.0	8
25			GBT3 SS Norte	82.9	81.7	84.5	87.6	86.3	86.3	90.2	8
26		AS Norte Total		83.9	83.6	84.5	86.3	87.2	85.5	87.9	8
27		AS Olivos	GBT1 Olivos	79.5	82.6	82.0	82.0	82.0	80.5	81.1	8
28			GBT2 Olivos	76.7	78.8	76.4	79.4	81.9	79.5	82.1	8
29		AS Olivos Total		78.4	81.0	79.3	80.8	82.0	80.0	81.6	8
30		AS Banao	GBT1 Banao	74.4	78.6	73.5	74.4	75.8	76.8	75.5	7
31			HL Banao	74.4	78.6	7.4	74.4	75.8	76.8	75.5	7
32		AS Banao Total		74.4	78.6	40.4	74.4	75.8	76.8	75.5	7
33		AS Guasimal	GBT1 Guasimal	100.0	100.0	100.0	100.0	100.0	100.0	100.0	10
34		AS Guasimal Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	10
35	Mun S Spiritus Total			81.4	82.1	72.3	82.9	81.1	82.0	81.4	8
36	Mun Trinidad	AS Trinidad1	GBT Tri Rural Pol1	73.3	73.3	74.9	79.0	73.8	72.6	72.9	7
37			GBT1 Tri Pol1	68.3	71.1	90.8	77.1	72.6	72.4	70.7	7

Datos Mensuales 02 / Datos Mensuales 01 / Sheet1 / Ind Mensuales 02 / Ind Mensuales 01 / Descrip. Ind. Mensuales / Pob.

Figure 28. Pivot table showing Drill-down for Sancti Spiritus Municipality

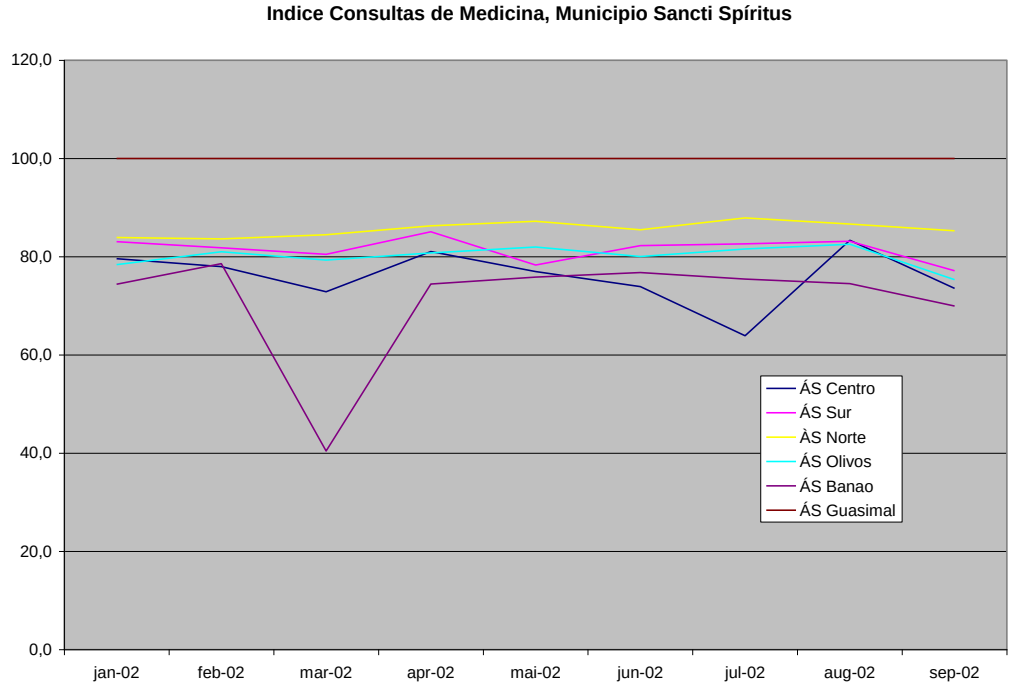


Figure 29. Percentage of medical consultations for Sancti Spíritus municipality.

The ability to then look at data separated in the health area is important. Figure 30 shows this health area, consisting of GBT1 Banao and Hospital Local Banao. The graph reveals that there is only something strange with the data from the hospital. It has around one tenth of the normal value, indicating a possible typing error.

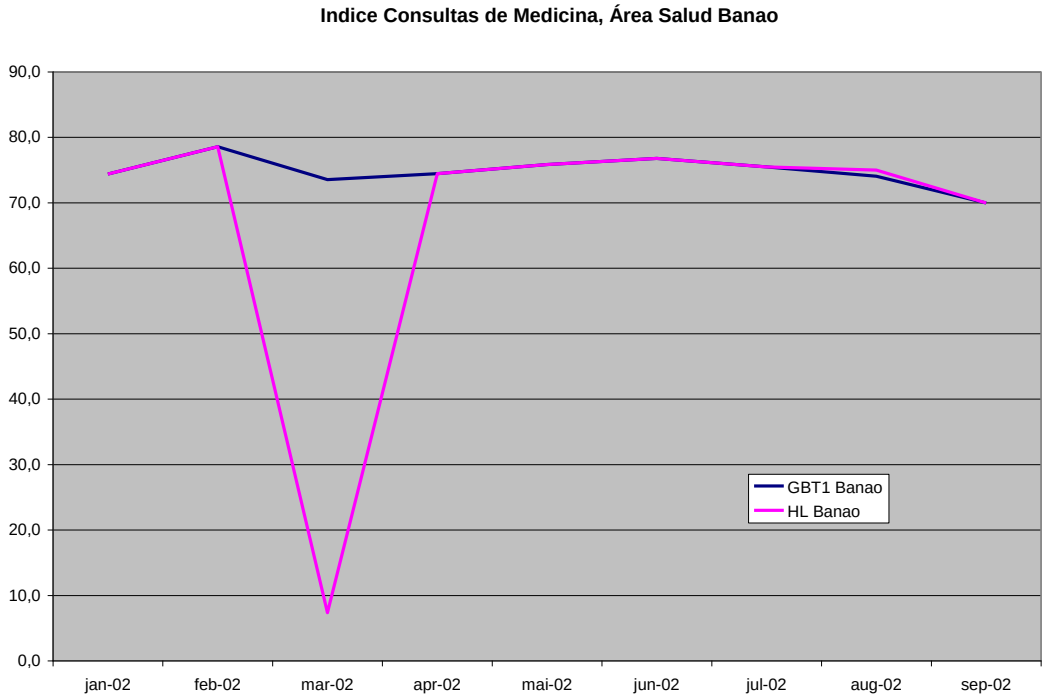


Figure 30. Percentage of medical consultations for Banao health area.

The last graph from the example, Figure 31, shows that there are large variations between the working groups in health area Norte, information that could not have been discovered by solely analysing the total figures for the health area (Figure 29).

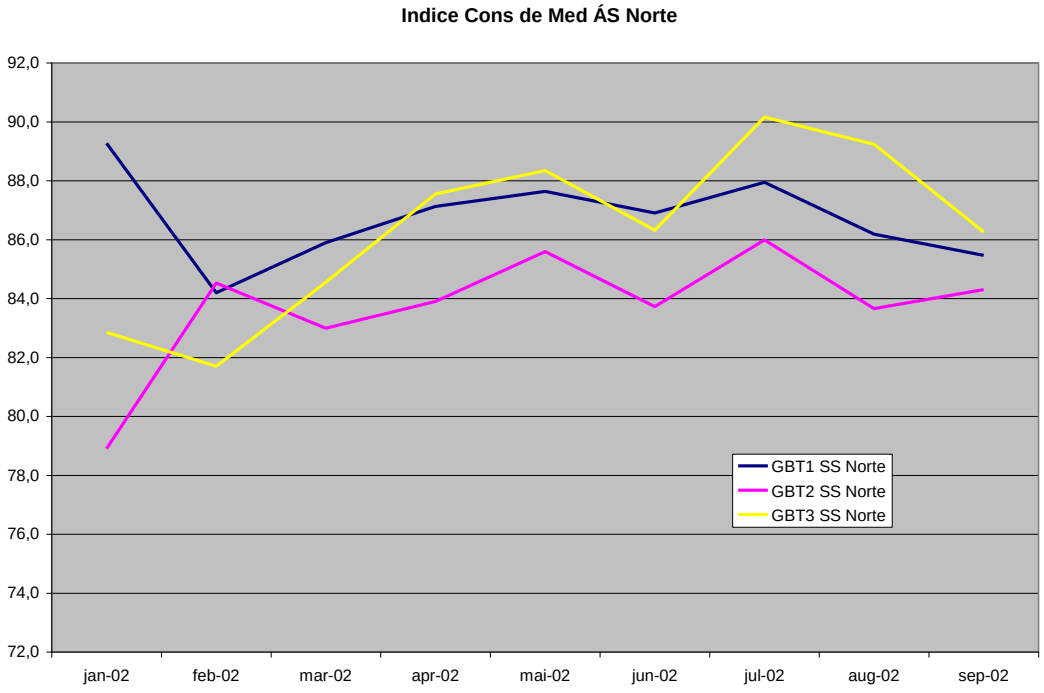


Figure 31. Percentage of medical consultations for North health area.

8.3 DHIS and the Municipality

As the municipality is the most suited level to administer PHC, we will here look at the possibilities for the municipal offices. Today data from municipal units (polyclinics, hospitals etc.) is reported via these offices on paper. Elements of certain interest, as infant mortality rate, are reported daily by phone all the way to the national level. Our experience is that there is little interaction between the statistics department of the municipality and the administration and decision makers. However, with easier access to analytic tools and report generators, there should be possible for the municipality to draw extensive information from the vast amount of data collected.

We have seen how the municipality can use the DHIS to fast and easy access data from the unit where it is entered. We provide an example of how this can be done in real life, together with proper ways to visualise these data. By visualization, e.g. making graphs, it is easier to see trends and get the big picture. Outliers are a lot easier to spot in a graph than in a series of numbers.

Example analysis: STI in Yaguajay municipality

As an example of the use of the data we will look at sexually transmitted infections (STI) in Yaguajay municipality. From an action-led information use perspective, the monitoring of STI is important regarding education, campaigns, free condoms etc. If there tend to be certain areas or certain months with higher numbers of STIs, this can be addressed more properly. This will not be an analysis of what the data mean, since that is beyond our expertise.

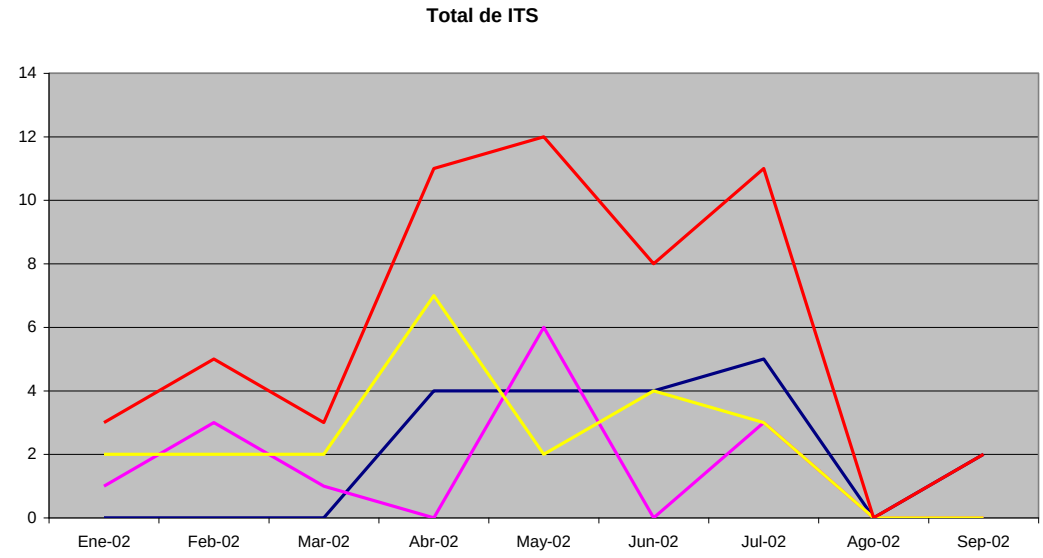
With the current information system, municipalities usually don't have access to working group data, only for the health area. Such data can be obtained from each polyclinic however. In the DHIS such data is available at all levels. Yaguajay is the only municipality we had both population data and good data for all the health areas and working groups.

We use the element *Total de ITS* (total STI), and the indicator *Tasa ITS*. The latter is incidents of STIs per 10.000 people, calculated by the formula;

Tasa ITS = Total de ITSx10000/Población Total

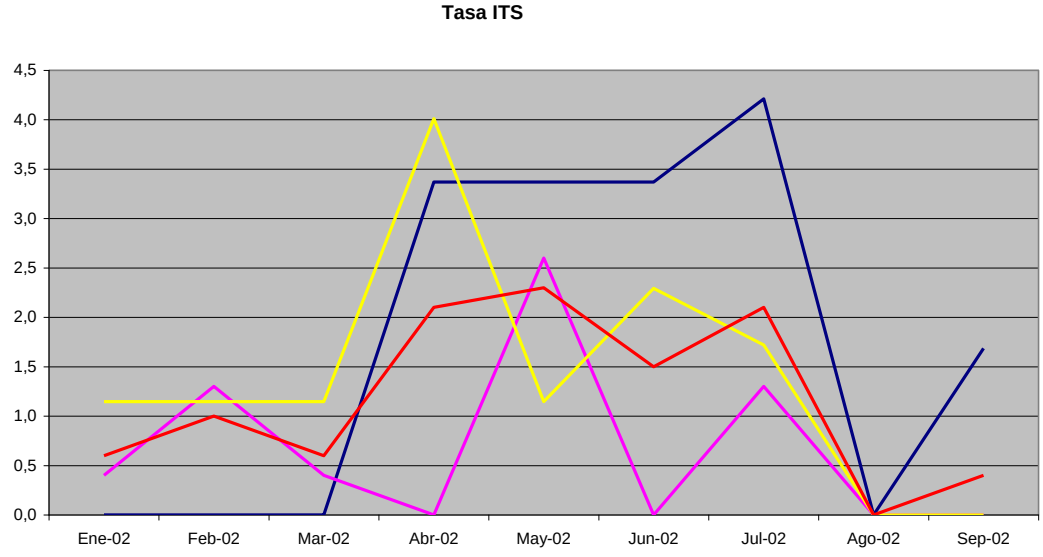
This indicator is a part of the data system, and when exporting data to the pivot tables, the predefined indicator is calculated and exported in the same way as raw data.

Figure 32 shows the raw data for STI in the health areas and the total for the municipality. This graph does not show how this relates to population. To do that, we need to use the indicator. When applied to population (Figure 33), the figures from Mayajigua and Yaguajay are higher than Meneses health area. When looking at the two working groups in Yaguajay in Figure 34, we can see that Loma appears to have higher prevalence of STIs. The total for the whole health area is easy to include or not using the pivot table.



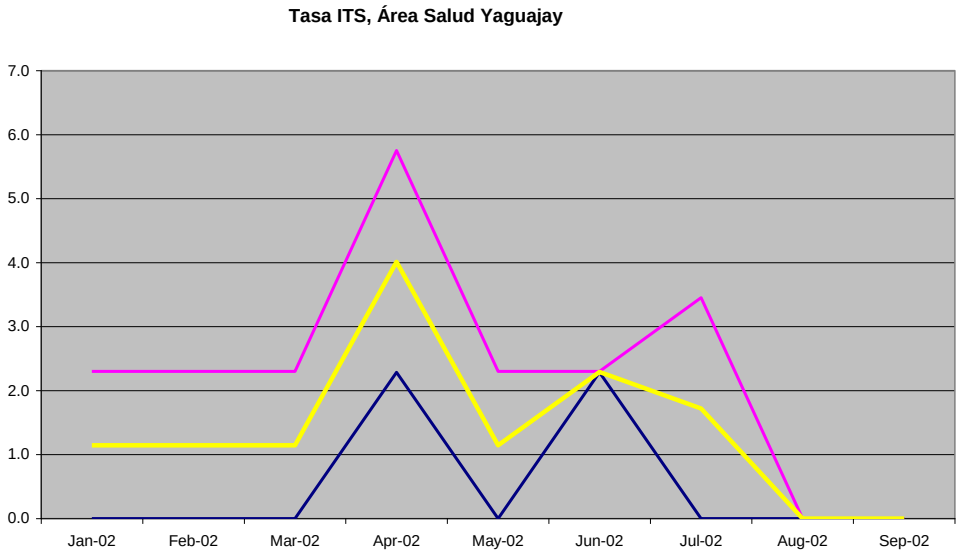
	Ene-02	Feb-02	Mar-02	Abr-02	May-02	Jun-02	Jul-02	Ago-02	Sep-02
ÁS Mayajigua	0	0	0	4	4	4	5	0	2
ÁS Meneses	1	3	1	0	6	0	3	0	0
ÁS Yaguajay	2	2	2	7	2	4	3	0	0
Total	3	5	3	11	12	8	11	0	2

Figure 32. Total incidents of STI in Yaguajay municipality.



	Ene-02	Feb-02	Mar-02	Abr-02	May-02	Jun-02	Jul-02	Ago-02	Sep-02
ÁS Mayajigua	0,0	0,0	0,0	3,4	3,4	3,4	4,2	0,0	1,7
ÁS Meneses	0,4	1,3	0,4	0,0	2,6	0,0	1,3	0,0	0,0
ÁS Yaguajay	1,1	1,1	1,1	4,0	1,1	2,3	1,7	0,0	0,0
Total	0,6	1	0,6	2,1	2,3	1,5	2,1	0,0	0,4

Figure 33. Cases of STI per 10.000 people for Yaguajay municipality.



	Jan-02	Feb-02	Mar-02	Apr-02	May-02	Jun-02	Jul-02	Aug-02	Sep-02
GBT Sansaric	0.0	0.0	0.0	2.3	0.0	2.3	0.0	0.0	0.0
GBT Loma	2.3	2.3	2.3	5.8	2.3	2.3	3.5	0.0	0.0
ÁS Yaguajay Total	1.1	1.1	1.1	4.0	1.1	2.3	1.7	0.0	0.0

Figure 34. Cases of STI per 10.000 people for Yaguajay health area.

With the polyclinic database, the family doctors could be compared. They have certain small areas each, as a neighbourhood or small rural settlement. These data could also be analysed in a number of different ways at municipality level. Unfortunately no data on STI has been entered so far in the polyclinic database, so we can not compare *consultorios*, family doctors, in the working groups. But we will present a graph showing the workload of some of them. Mayajigua working group has 31 family doctors, and the total numbers of consultancies per 10 000 inhabitants of the first 5 are shown in Figure 35. As can be seen, there are great variations. One doctor very varied figures for the last month, but there are also discrepancies between the different family doctors. Each of the family doctors has a "pool" of patients, the inhabitants of the doctors' neighbourhood or area. These figures are entered in the database, and used in population related indicators. The ability to use such indicators on as small populations as a few hundred is quite unique in the world, and a benefit the municipalities and polyclinics should take full advantage of.

Further analysis on the case of STI can be done. It is possible to see if there is any difference between the rural and urban populations. With other data elements monitoring medicines in stock, condoms distributed etc, it will be possible to see if there is any correlation between these elements.

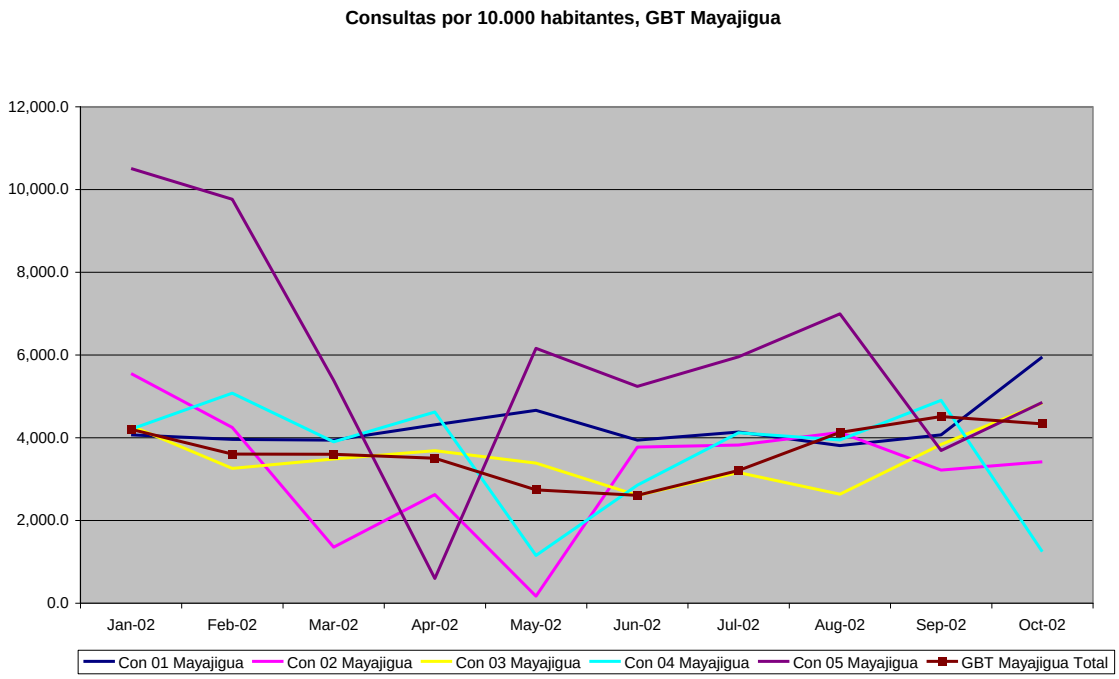


Figure 35. Consultations per 10.000 people for 5 family doctors in Mayajigua.

What new possibilities do the example show compared to the system in Cuba today? First, it shows the power of the pivot tables for analysis. Data can be compared in any way possible with easy manipulation of the tables. Further, indicators made in the database transforms data into information, automatically calculated and ready to use along with raw data in both reports and pivot tables. Today data at the health units is aggregated before it is submitted on paper to the municipality office. They then often loose the option to see each working group, since the data is for the whole health area. With DHIS the data is stored as it was entered. All data above that level is just temporarily aggregated from the lower level, and so all levels can be seen from every level if desired.

For preventive health care it is of utmost importance to catch and analyse health data as soon as possible. The DHIS allows this to be done in the municipalities. Easy manipulation of data and visualization would give the municipalities powerful tools to produce information that should lead the way for action.

8.4 Data quality

The Cuban health information system gathers enormous amounts of data. Each family doctor reports on a daily basis to its polyclinic, where thousands of statisticians around the country aggregates and process these data. Is this data of good quality? It is hard to know the extent of human error in the reporting and aggregation processes. Pen, paper and calculators is the normal tools. We were once asked at a polyclinic, after demonstrating the DHIS and its possibilities, if we could not get them some more calculators too.

A known problem is that entries ending in 5 and especially 0 is more often reported than other values. The reason is that the person reporting does not have the exact figure, and use an approximation instead, often choosing values like 5, 10, 20, 100 etc. We have checked all data records in the municipality structure and polyclinic structure. After taking away all empty entries (i.e. "0") we sorted the total 41.991 entries left according to how often each value is used. The reason for not using entries with "0" is that the small percentage of zeros that might have been entered without roots in reality will drown in the large amount of real entries of "0". 30.000 such entries were not included in this examination.

As expected we found little evidence that a lot of the Cuban health data is approximations of the exact figures. However, there seemed to be some tendencies that this could happen, especially when the number was higher. This is what we found in the examination:

- For the 80 most used values, the list was linear ascending. "1" was the most used value, "2" the second most used etc.

- Among the five most used values between 100 and 200, three ended on "0"

- After the 100th, most values ending on 0 were higher up on the list than their value would imply, meaning they were used more often that they would following the rule "1" is the most used, "2" is the second most used.

- All values ending on "00" (100, 200, 300 etc) were used more often than values in the similar range, e.g. 101, 204, 299, 324

- Some high values were used a lot, like 2800, 3000 and 3100. This turned out to be *Dias Camas*, Day beds, where a hospital with 100 beds had reported for 28 (February), 30, and 31 days. Other common values for this elements were 700, 750 and 775 (25 beds).

It would be interesting to investigate the correlation between values ending in 0 with other values, but there are so many entries with low values that a comparison becomes difficult. However, the use of the element *day beds* indicates that there is a natural explanation for the higher prevalence of such values.

While studying *Movimiento Hospitalario* (MH) data in the pivot tables great irregularities were found in 2002 data from the municipality of Camagüéy. Fewer than normal units from the Camagüéy municipality had reported data in the two last quarters of 2002.

To understand why this had happened, the original MH FoxPro data was studied. In the two last quarters of 2002 a large number of records were reported for a Camagüéy municipality with the internal MH FoxPro municipality code 98. This municipality code is not valid, there is no municipality with that number in any province. However there was a large number of missing records for municipality Camagüéy (with code 08). At the provincial office for Camagüéy, records for this municipality had apparently been entered with a wrong municipality code. Figure 36 shows the amount of hospital

services entered for Camagüéy, with *Lost services* referring to the reported services we found for municipality code 98.

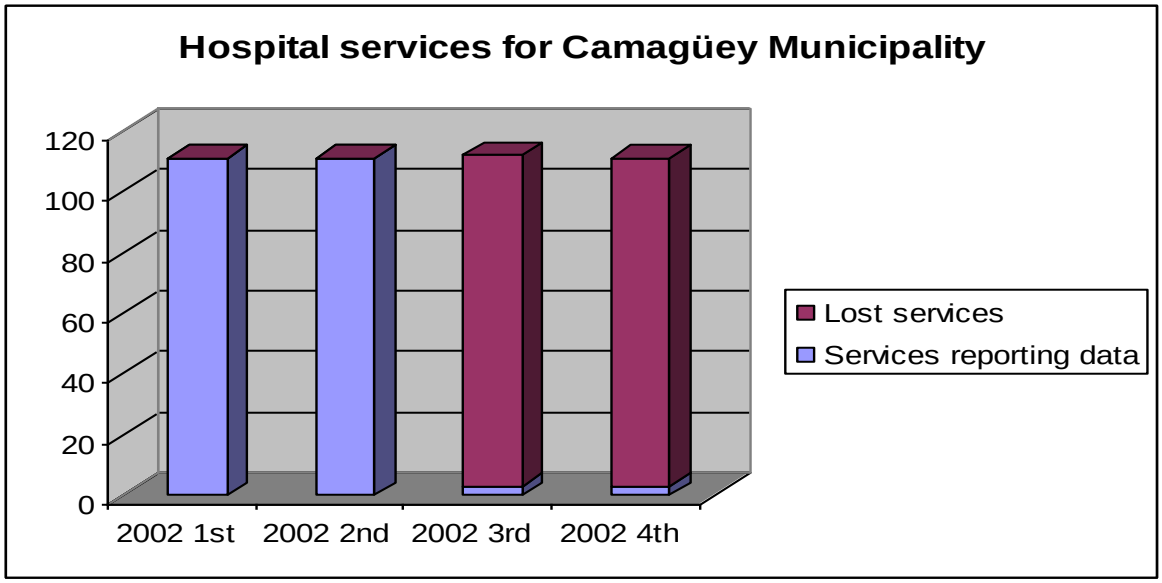


Figure 36. Amount of hospital services entered with wrong municipal code

PROV	MPO	UNIDAD	COD_SERV	PERIODO
09	08	999	1000	2002/03/01
09	08	999	1001	2002/03/01
09	08	999	1002	2002/03/01
09	98	411	0000	2002/09/01
09	98	411	0100	2002/09/01
09	98	411	0102	2002/09/01

Table 9. Data extracted from the hospital structure database

The table shows the difference between records in first and third quarter 2002. *Prov* is Province, *Mpo* is Municipality, *Unidad* is Unit, *Cod_Serv* is ward at the unit, and *Periodo* is the month the data is valid for. Month 3 is the 1st quarter. In province 09, which is Camagüéy, there is no municipality 98. Municipality 08 is Camagüéy municipality, in the city of the same name.

Since the FoxPro data had not been updated, we must assume that the MH reports had never been corrected. Does this mean that the reports are not used? Unfortunately, we did not further investigate into these errors at the time of discovery.

Thus, it is not possible for us to know if these errors were discovered or not. Municipality Camagüéy is the municipality of Cuba's third biggest city, and as we can see more than 97% of its normally reported data were lost for the second half of 2002. Judging from the extreme impact this mistake has on the provincial statistics, the errors have most likely been noticed.

When errors are discovered feedback is probably given to the provincial office where the erroneous data were created. However, a new national report has not been created, since this would have to be done through the MH FoxPro system. The MH FoxPro database has not been corrected, since the data we have is exported from that database. This suggests that MH data is not corrected if errors are found after the creation of reports.

When doing a historical analysis several quarters are compared. Uncorrected reports reduce the value of such analysis, especially when errors are as big as discovered above. The example also shows a weakness of the current computerised systems in use on Cuba. If codes determining the health unit have to be entered each time, the risk of wrong reporting as seen in the example gets higher. Using the DHIS will eliminate such errors, since the health unit is selected from a menu.

Other hints of bad data quality are sudden large fluctuations. An example is the earlier graph in Figure 30 from Banao health area. We remember that there was a 90% drop in *Indice de Consultas Medicina* for March 2002. The actual numbers behind the indicators showed the numerator was only around 10% of normal value. With ranges and validations this would be caught, and it could just be a typing error not likely to happen when handwriting on paper. Cuban health data

Some data analysis have been made in other countries HISP is involved. In India there were several population counts, causing some problems for the indicators. There were discrepancies from the official state census and the household registers of the health workers. The household registers matched much better with the actual reported data, but they came from the same source. The health workers figures could therefore be biased, and the official census was considered the most correct. The Cuban population data in the database presented here is from 2001. It is one official census, and only figures from this are used. Further, only about 70% of live births are recorded, as many prefer to give birth at home, and the health workers may be unaware of the delivery. The researcher found that much data was not available, because it had not been recorded (Meland 2003). In Cuba there is almost the opposite problem; too much data is collected. With the scarce possibilities for local analysis it is obvious that the data is collected for the central planners. We refer to section 9.1.2 for a more in-depth discussion on this.

In Mozambique the latest census at the time the analysis was done was from 1977, and civil war and internal refugees had made that census useless a long time ago. Results from a new census were being distributed in late 1999. Due to bad data quality and wrong population figures, immunization coverage could range from 20% to 150%, which is impossible (Braa et al 2001). The quality of data in Cuba is much higher than it seems to be in Mozambique.

The overall impression is that Cuban data is of good quality, and that the collection of it is seen as a serious task. And that is believable and understandable considering the large amount of statisticians working with this information system. The problem seems rather to be manual work routines that allow data to be lost due to reading and writing errors, and that information is lost when aggregating data. Disaggregating is impossible when first aggregated, and analysis is a time consuming and tiring task. Often the right data to do optimal analysis is not available due to the aggregation. As Feldman and March (1981) pointed, too much data seems to be collected by organisations in general.

8.5 Summary of analysis of benefits with DHIS in Cuba

The data quality in Cuba is good, but is not facilitated electronically at municipal levels. At provincial and national level data is available aggregated for the level below, the municipality or the province. A computerised system like DHIS will provide validations, safe and easy reporting, save paper, and be a powerful tool for analysis. The most important facilitation, however, is to enable disaggregated data storage and use. As shown in Figure 37, the DHIS enables the municipality to see much more data, as the working groups are the main providers of PHC. Together with indicators, DHIS provides a powerful tool for analysis and presentation at all levels. It is possible to map the database to geographic information systems (GIS) and thus present data in layers on maps. The data analysis gives a good indication on the power of the analytical tools. Today the amount of analysis done at the municipality is little, and it has to be done with pencil and paper, sometimes with the aid of calculators.

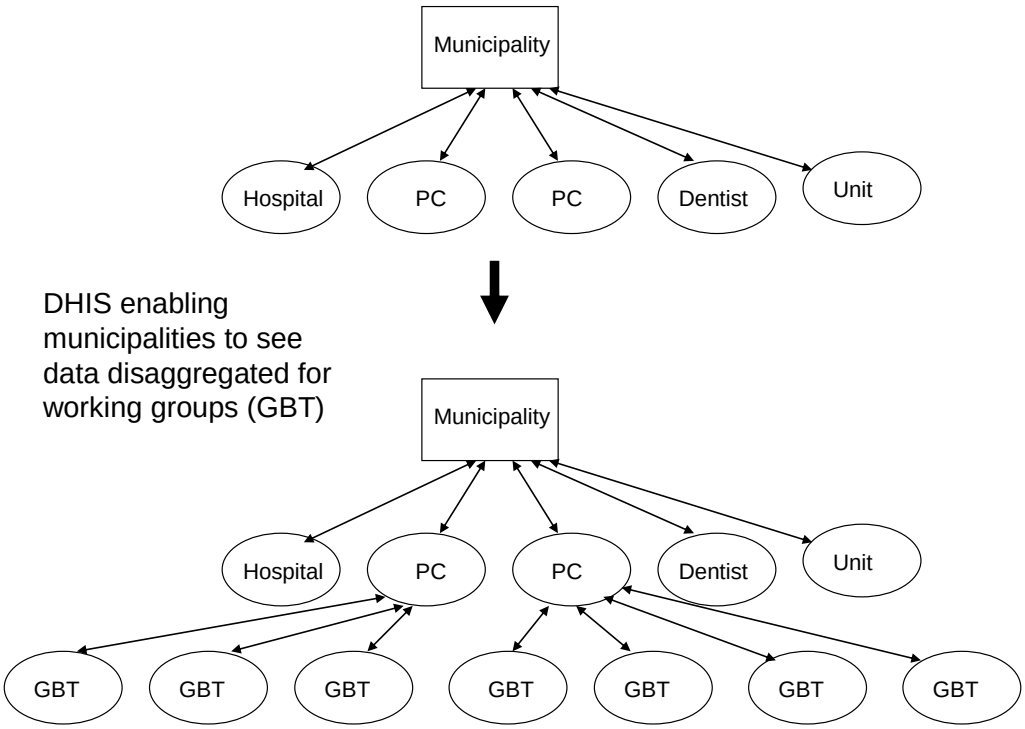


Figure 37. Overview of aggregation in the municipality

Explanation: Using DHIS, the municipality is able to see data disaggregated for each working group. This is an important step to make the municipality more able to do local analysis. PCs are polyclinics, GBTs are working groups.

The most important potential benefits of DHIS in Cuba are:

- Access to local data, from any level
- Powerful analytic possibilities in the pivot tables
- Easy graphical presentation of data

Potential benefits of implementing the new HIS in Cuba

- Correct data through automatic validations
- Work- and paper-saving procedures and storage

Part 4 Discussions and Conclusion

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BILDE

Picture XX. Training session in the Mayajigua polyclinic.
From left: local statistician, chief of working groups, local statistician, and Norwegian consultant.

BILDE 2

9 Discussion

In this chapter we explore our research objectives and discuss our empirical findings by drawing on literature and concepts presented in chapter 2 and 4, and on international experience from other HISP projects presented in chapter 3.

Research objective 1) *Study the context for systems development in Cuba more generally and within the health sector more specifically*

We will not address this research objective directly in these discussions, however, the findings from this study which have been presented earlier in this thesis, form an important basis for the discussions on the other three research objectives.

Research objective 2) *Discuss and explore appropriate approaches to systems development and HISs in a Cuban context*

We address this objective by discussing the specific findings from the Cuban case study with a focus on the approaches to systems development in context, health systems reforms and HISs, and organisational change and political brokering. We will explore more appropriate approaches to systems development and HISs in a Cuban context. Furthermore, we evaluate the software tool and explore whether it provides the flexibility and adaptability needed to support a context sensitive approach.

Research objective 3:
Compare systems development experiences from Cuba with case studies from other HISP nodes and explore appropriate approaches to systems development in developing countries in general

This we address by extending the research area to a more global context and compare our Cuban findings with existing case studies from other countries where the HISP-approach has been implemented.

Research objective 4:
Present and discuss different perspectives on the term technology transfer

Based on the Cuban findings and results from the global comparisons, we discuss the term technology transfer and relevant theory exploring a more appropriate understanding of the transfer process.

The following sections will be presented:

9.1 - Systems development in context - developing an HIS in Cuba
9.2 - A technical evaluation of the software (DHIS)
9.3 - Cuba compared to other countries in the HISP network
9.4 - Technology transfer in a critical perspective

9.1 Systems development in context - developing an HIS in Cuba

In this chapter we address research objective 2, and more specifically discuss three important aspects of the HIS development process in Cuba;

9.1.1 - Approaches to systems development
9.1.2 - Approaches to health systems reforms and HISs
9.1.3 - Organisational change and political brokering

9.1.1 Approaches to systems development

The HISP-approach applied to develop a Cuban HIS consists of approaches for systems development that are influenced by Scandinavian literature on IS development. These approaches proved successful as a point of departure when developing the South African HIS, and relatively successful also in development and adaptation projects in Mozambique and India. In this section we will discuss the appropriateness of these approaches in a Cuban context. We will put forward important empirical findings and discuss them in light of relevant theory on information systems reviewed in chapter 2.

Experiences from a local development approach in Cuba

The development process in Cuba has been turbulent due to a variable political support, and there has been a huge variation in the Cuban acceptance of applying a HISP-approach. While we started the project with a broad consensus for a locally focused development approach, that approach soon resulted in conflicts between the Norwegian researchers and the central level (ref. 7.4.3). The DNE pushed the development approach towards a centralised top-down process, and finally the project was stopped. We will discuss some experiences from these two phases:

1st phase: Cooperative design and prototyping at the local level

To meet the objective of developing an HIS to support local health management (ref. 6.1), we initiated an approach that focused on designing a locally adapted system *in* the local context. By designing at the workplace of the local health statisticians and health managers we wanted to establish a cooperative design process (Greenbaum and Kyng 1991) where domain skills of the local workers and our computing skills were given equal importance (Bødker and Grønbæk 1991).

The pilot database was designed in cooperation with the central level in Havana based on a national perspective of local work processes, and later, this pilot was continuously improved and redesigned during the development at the local levels (ref. 7.4.2). The way we designed and adapted new variants of the pilot system to better fit the local contexts of the different levels, has similarities with the evolutionary prototyping process described by Pape and Thoresen (1986).

The fact that we had a functional pilot system when we started the local adaptation process facilitated the use of the prototype as a tool to communicate with the local workers. Another positive experience was how we could quickly implement and test out

new design ideas supported by the flexible software (ref. 7.1). In this way we facilitated an important requirement in cooperative prototyping; to bring the current skills of the users in contact with the new technological possibilities (Bødker and Grønbæk 1991).

This way we conducted the prototyping process has elements from both evolutionary (Buddhe et al. 1991) and cooperative prototyping (Bødker and Grønbæk 1991), and it was applied with improvisation (Braa and Hedberg 2002) in the sense that any interested user in the local health offices was invited to participate.

The prototyping sessions were integrated parts of our local visits and were carried out as discussions on local work processes and possible technological solutions to support them. These discussions can be understood as mutual learning processes (Bjerknes and Bratteteig 1995, Ehn 1993, Greenbaum and Kyng 1991, Bødker and Grønbæk 1991, and Walsham 2002) where the local workers learned about the new system and its potential benefits, and we as systems developers gained crucial knowledge about the application domain. In some of the places we experienced that this equality between the two collaborating parts resulted in local commitment and enthusiasm towards the new system, and important step towards local ownership and sustainability (Grudin 1991, RHINO 2003 and Korpela 1994). However, in other places the cooperation was more like passive participation and resembled traditional design were we did all the questioning and utilised the requirements of the users (Bødker and Grønbæk 1991). These differences in cooperation and commitment will be discussed in the following sections.

As we had a tight travelling schedule with many pilot workplaces to visit (ref. 7.5), the local workers had limited time with the system developers, which was negative for cooperative learning process. However, an important part of the users' learning was to use the prototype actively in a natural work situation (Greenbaum and Kyng 1991) without the developers' presence. Even though we would have liked to spend more time at each place to get a closer cooperation and more local commitment, by visiting many different places we gained a broader understanding of the local processes. Optimally, we would have liked more trainers and developers to be engaged in the project, especially Cubans from the national or provincial levels, but as mentioned, despite that this was among the objectives (ref. 6.1) in the terms of reference paper, it was not a priority at the DNE.

2nd phase: Conflicts and change of approach

After three months of local development actions, the DNE management stopped all activities in the two provinces and demanded a new approach with 100% focus on the national level. Much efforts invested by the local levels were neglected by the central decision-makers, and many potentially good development processes were stopped and never continued. The DNE management explained that their need to change the development approach was based in a lack of control of local project activities. We argued the need for involving the local level in order to follow the objective of developing a locally adapted system, and that this was impossible to achieve with a development solely at the national level.

This scepticism towards a locally focused approach is not just based in a centralised political system; it is also to large extent based in a completely different understanding

of systems development. In the literature review (chapter 2) we have presented two quite different perspectives on information systems, the technological deterministic and the social systems perspective. In many ways we can say that the two different perspectives found at the DNE and within the Norwegian HISP team represent these two perspectives, with the DNE as the technological determinists.

The DNE management saw the computerised health information system that we were developing as a pre-made software product (DHIS). They understood the system as something they could just install at the pilot places, and then by training the statisticians in software use, achieve a functioning HIS. The present computerised systems at the DNE and at the provincial offices follow this view; they are pure reporting systems with limited features that are easily controllable. This type of system fit well with the description (Kling et al. 2002) of a system applicable with technological determinism, and aligns with the data-led HISs described by Sandiford, Annet and Cibulskis (1987). The new system had a different focus, aiming at supporting local use of action-led primary health care information, and thus relied more on local involvement and ownership than the traditional top-level systems.

The DNE did not agree on the need for local participation and to spend so much time out in the two provinces, as this context sensitive approach was completely new to them. They argued that a top-down approach with development solely at the national office had always been a success in Cuba, and that we should follow this tradition. There is no tradition for involving local levels in decision-making, and the DNE did not agree that local involvement in the development would lead to a better system. This citation from the DNE management illustrates their view of bottom-up processes:

"The local health managers do not know what good information is and they do not know what data that is important to them" (the DNE management)

Our meetings with the health software developers at the CEDISAP group clarified that the Cuban traditions of systems development are top-down processes with little local involvement. We were told that the DHIS software was not safe to implement due to its end user flexibility (ref. 7.4.4), and this illustrates how the properties of the DHIS software clashed with Cuban traditions of computerised health applications.

The learning process of transferring a social systems understanding of information systems failed, and this failure was crucial to the project. The DNE did not understand our need for a context sensitive approach and thereby we had little political support to involve the local level.

When we see the differences in understanding of local systems development outlined above, it is interesting to discuss why we could follow the locally focused approach for three months. The most likely reason is that the DNE did not fully understand the local approach, and at first they did not realise that the local statisticians and health management participated in the design of the system. We had to go to the provinces to set up the hardware, install the software and train the users, so it was natural to spend much time at the local level the first months. First when we started to complain about the difficulties of involving local health management, the DNE started to feel that we involved the local level *too* much, and that our intentions of visiting the local pilot sites included more than just training and installation. To some degree the administrative change process in MINSAP (ref. 6.2.3) has something to do with this change in

approach. We started the bottom-up approach prior to the MINSAP change process at a time when we had strong political support. When we came back to continue the local processes after the MINSAP change, we were told to keep a low profile, but the processes were not stopped. However, after another two months the DNE probably felt that we made too much out of the project by involving too many locals outside the health statistics department, and then they decided to terminate all local actions.

As we can see, the design process has been quite turbulent with rapidly changing requirements. A varying political support from the central level, lack of paper and lack of computer resources (ref. 7.2) as well as varying needs at different levels in the health system, have contributed to a complex development process. Thanks to a flexible database tool and a flexible design approach these changes were manageable, and in the end we came up with a compatible set of locally adapted database structures aligned with the political decisions as well as the scarcity in resources. The participatory approach yielded information about the local processes, which could not have been obtained in any other way (Sæbø and Titlestad 2003, see Appendix E).

These locally tailored database solutions could not have been developed from a distance, say in a computer lab in Norway or even at the national level in Havana. A traditional design approach (ref. 2.1.3) with an early requirements phase and clearly separated development phases would not have been flexible enough to take both the need for local learning and the rapidly changing requirements into account.

Coverage and scale factors in the trade-off between local and central needs

The change in approach and shift of focus from the local to the central level also marked a shift in how scale and coverage was achieved. When initiating the 1st phase aiming at full provincial coverage the number of computers in the two provinces was limited. This resulted in a limited computerised coverage in each province, as four out of eight municipalities in Sanctí Spíritus and twelve out of fourteen in Matanzas were without computers. An essential dataset was developed to facilitate full provincial coverage combining paper and computerised reporting of locally useful disaggregated data (ref. 7.2). The dataset had to be small enough so that the municipalities without computers could report equally disaggregated data to the provinces, where it would be entered into the database, still with a locally useful level of aggregation. A larger dataset would require a higher level of aggregation to maintain data quality (Braa, Sæbø and Titlestad 2002), thus removing the locality of it. Targeting improved local use of information we prioritised scale in the sense of more reporting units and more locally useful information, than scaling up the size of the datasets to better cover the maximum datasets of the present HIS.

At about the time when the development approach was changed, 60 more donated computers arrived from Norway. This amount of computers was sufficient to cover the two provinces at municipal level, which would have been an important step towards increased local use of information. However, as the DNE wanted a more centralised approach, they prioritised to scale up the amount of data reported going for maximum datasets. Furthermore, they were interested in national coverage of these maximum datasets to better support their needs at the central level. They suggested that all provincial office were equipped with computers and the new DHIS-version of the hospital subsystem (ref. 7.4.3). Regarding coverage, it was more important to the DNE

to completely cover a subsystem using a maximum dataset with a high level of aggregation (ref 7.4.3) reported from all provinces, than improving local coverage within the two pilot provinces. These two dimensions of information coverage and scale in HISs will be further discussed in section 9.1.2.

Analysing the participatory approach

We have many interesting findings related to applying a participatory approach in Cuba. In many ways it has been problematic to achieve a good cooperative development process, and we will go in depth on some of the reasons for this. Furthermore, given that we had quite varying experiences with participation, we will analyse the different experiences from all the sub-cases and put forward some more general assumptions for applying a participatory approach in a centralised Cuban context.

We start by discussing the contextual constraints to a participatory approach in Cuba under the following four headings:

1. The fragmented health structure
2. The Soviet-model for use of statistics
3. No central political will to local participation
4. Not a culture for low-level participation and different opinions

1. Participation problems due to a fragmented health structure

The Cuban health system is a fragmented structure (ref. 5.5.4) with several micro-powers in the hand of national directors. Each national director has its own vertical hierarchical structure and line of command, and based on our experiences, there seems to be little interdepartmental collaboration.

The primary health care approach (ref. section 2.3.2) emphasise integration of different sectors in the community and also within the health sector itself. An information system to support such an approach demands the same degree of interdepartmental collaboration and integration. Important users are the health managers as users of the information, the statisticians as data clerks processing the information, and IT staff to support the users and maintain the system. In our sub-case descriptions (see section 7.7 and Appendix C), we have described the participation with these three user groups for each pilot site.

Our working domain has been within the health statistics department, a department administered by the DNE director. In our participatory design approach we wanted participation from all the three user groups mentioned above. Especially important is the group of local health managers, considering that the HIS we were developing was aimed at strengthening local health management. However, the DNE administration has been very clear in its strategy to only involve personnel from its own line of command, the health statisticians. We experienced that instead of being able to freely select participators based on the needs of the development process, this selection was limited and controlled by power relations within the health system (Bødker and Grønbæk 1991, Heeks 1999a), which in many ways hampered the cooperative design process.

The next section discusses the role of health statisticians in more detail, but as we have described in 5.5.7 and 7.4.4, the health statisticians in Cuba are not involved in data analysis or information use, which made it even more crucial to involve health management. The DNE wanted to keep the project as a health statistics project and had no interest in involving other sections of the health system. The insecure political environment after the administrative changes in the MINSAP (ref. 6.2.3) gave the DNE administration even more reasons for keeping the project within health statistics and as invisible as possible. The incident from Sanctí Spíritus where the DNE completely overruled a provincial decision to arrange a provincial HISP seminar involving both statisticians and health management (7.4.3 and 7.4.4), illustrates how the DNE wanted to control and keep project actions within the statistics department.

The CEDISAP is a group at the central level in the Cuban health system that develops health software, and this group has developed many of the computerised reporting systems that are used at national and provincial level. The CEDISAP has several skilled IT personnel, system developers and programmers that have experience with health information systems. From the Norwegian side of the collaboration this group seemed as a perfect participator in the design process, and also an important group considering sustainability and knowledge transfer (ref. 7.4.4). CEDISAP, in contrast to the DNE, had the human resources to secure a sustainable Cuban HIS and to further develop and improve the system to the Cuban context. We had two meetings with a representative from CEDISAP and planned that one programmer would join us in the design of the hospital database. However, this plan was never realised and we had no collaboration with this skilled group.

Given a more interdepartmental project in Cuba we could have achieved a much more cooperative process, incorporated more worldviews from a broader selection of stakeholders, and built a more sustainable Cuban system. But, unfortunately this was not possible due to the fragmented structure and a strong will at the health statistics department to keep the project within their line of command. In section 9.3 we discuss the reasons for this strong need of central control, and try to understand the internal power relations of the health system.

2. Participation problems due to a "Soviet-model" for use of statistics

Cuba has one of the most comprehensive health statistics systems in the world, reporting an enormous amount of data in a timely and structured manner (ref. 5.5.6). There is an armada of educated statisticians at the very lowest levels of the health system, and an extensive reporting structure in the health statistics department all the way up to the national health statistics office (the DNE) in Havana.

However, despite the potentially good quality information this health statistics system provides, there is little local use of data in health management, and overall little focus on action-led data (ref. 2.3.3). Cuba's centrally planned economy (ref. 5.3.2) has many similarities with the planned economy model of the former Soviet Union, and as in the Soviet Union, the statistics offices play an important role in providing the statistical material needed to monitor whether the plans are fulfilled or not. In such a system, the information systems focus on monitoring and measuring fulfilment of centrally defined plans at the central levels, rather than on local use for improved quality of services. Braa (1997) describes the same type of statistical system in a study from Mongolia, and he

points out that the health information system is a "blueprint" of the state statistical system as it has the same ethos of the planned economy inscribed into it. Instead of planning better quality of health care, the planning is concerned with quantitative issues like planning for more beds and patients in hospitals.

The present Cuban health information system is defined to support the quantitative needs of the planned economy, and its main purpose is to receive as much data as possible at the national level. We wanted participation in designing a system that could enable local information use, and our working domain was the health statistics office. However, the statistics offices we visited saw their job more to serve their top level than the local management structures. As a consequence, the local statisticians had little interest and knowledge about data analysis or information use (ref. 7.4.4). With some exceptions, the involvement of statisticians did not provide the cooperative design process needed to develop an HIS for local use. A truly cooperative process would have required involvement from local health workers and managers.

3. Participation problems due to lack of central political will to local participation

As we have explained earlier, a focus on the local level and an involvement of local stakeholders were not prioritised by the national level. In addition, the DNE had no interest in involving other sections of the health system at any level, so there was little political support to let the local health management participate in the design process.

In a centralised context with little local autonomy, it becomes extremely important to have central political support in order to get anything done at the local level. Without clear orders from the level above there is not much hope to get a successful participatory process.

In the authoritarian health system control is extremely important, and to the DNE management this means controlling all actions in their own line of command. By empowering local workers down the hierarchy the power balance within health statistics would be altered and represent a power change the DNE management would resist (Kling 1980, Markus 1983). Even though the DNE management realises that improved data processing and use of health information at the local levels would lead to a better system also for the national level, the need for central control limits to what extent they allow empowerment of the local levels. Therefore, they pushed towards a more centralised top-down development approach focusing on the needs of the central levels. The national level wanted a computerised system that could strengthen the present vertical reporting structures and central monitoring functions; political objectives that did not align with a local-level participatory approach.

4. Local participation and expression of own and different opinions not facilitated

The strong hierarchical structure of the Cuban health system has affected the participatory approach. Participation and cooperation have been successfully applied in many Scandinavian projects, mostly in democratic contexts where rational criticism and low-level participation is accepted and part of a general openness. Also in South Africa and Mozambique such a democratic process has proved successful. The Cuban context is a centralised and controlled context where criticism and questioning of orders or system functions are seldom heard in public. This closed environment is a difficult

context for raising competing and different opinions, and thus a difficult context for applying a participatory process. At least we can say that the possibility to express own and different opinions is not found in the same way as we are used to from e.g. Scandinavia where a much more open debate is facilitated. However, there might be other ways or channels of criticism and expression of competing views in the Cuban culture that are different from our understanding of it. The participatory methods we have used assume the "South African way" of expressing opinions, and may have neglected a "Cuban way".

In (Sæbø and Titlestad 2003, see Appendix E) we compare these experiences with a case study of a development project in Thailand that describe similar difficulties of user participation in another culture where the hierarchical power is strong. There the system user did not want to confront the management and held back important information, which in turn complicated the development.

In the Cuban health system, personnel at the lower levels are not used to being included in decision-making and discussions on system design. Then suddenly, some Norwegian students entered their office and wanted *them* to come up with ideas and suggestions on how to better design an information system to fit *their* needs, no doubt that this change created a bit of a cultural shock in many local offices. The fact that there is no tradition for local participation in the Cuban culture complicated the cooperative design process we wanted to establish.

Analysing experiences with participation from the sub-cases

If we look at the sub-cases (ref. 7.7 and Appendix C) and the descriptions of participation at each place with the three different user groups, we can see that there are quite different experiences amongst the pilot sites. If we categorise these differences we can see that we had better participation at the lower levels than the higher levels, and also better participation in more rural isolated places than in places with easy access from the capital. Poor transportation and infrastructure creates decentralised units where people have to take decisions themselves. Participative approaches in these nodes tend to be very fruitful (Sæbø and Titlestad 2003, see Appendix E).

The best participation experiences are from the pilot places where we managed to get participation from all three kinds of user groups, and especially, an active involvement of the local health managers. The Mayajigua polyclinic (Appendix C) is a great example of such a participatory process. In this rural polyclinic we had interesting discussions on local use of information with the management, and also discussions on system improvement with the IT-skilled statistician. Given more time to training, this polyclinic could soon have started to benefit from a computerised system tailored to their local needs for health management. The polyclinic in Fomento is another example of a good participatory process, as is the municipal offices in Yaguajay, Sanctí Spíritus, and Trinidad (ref. Appendix C). These experiences align with the more active variants of participation, as the cooperative design approach (Greenbaum and Kyng 1991).

At the central and provincial levels we had much poorer participation experiences and no or little contact with the health management. In addition, the central level did not have the same commitment as in the cases described above, and the participatory processes were passive and not as cooperative as we would have liked. The municipality

of Jagüéy Grande, which is on the highway just outside Havana, is the pilot site where we invested most time and computer resources. Despite this, we had limited participation from local health management and here more than in any other place in the two provinces, we felt "locked inside" the health statistics department.

Figure 38 gives an overview of participation in the pilot sites presented in a hierarchical way and with distances to Havana.

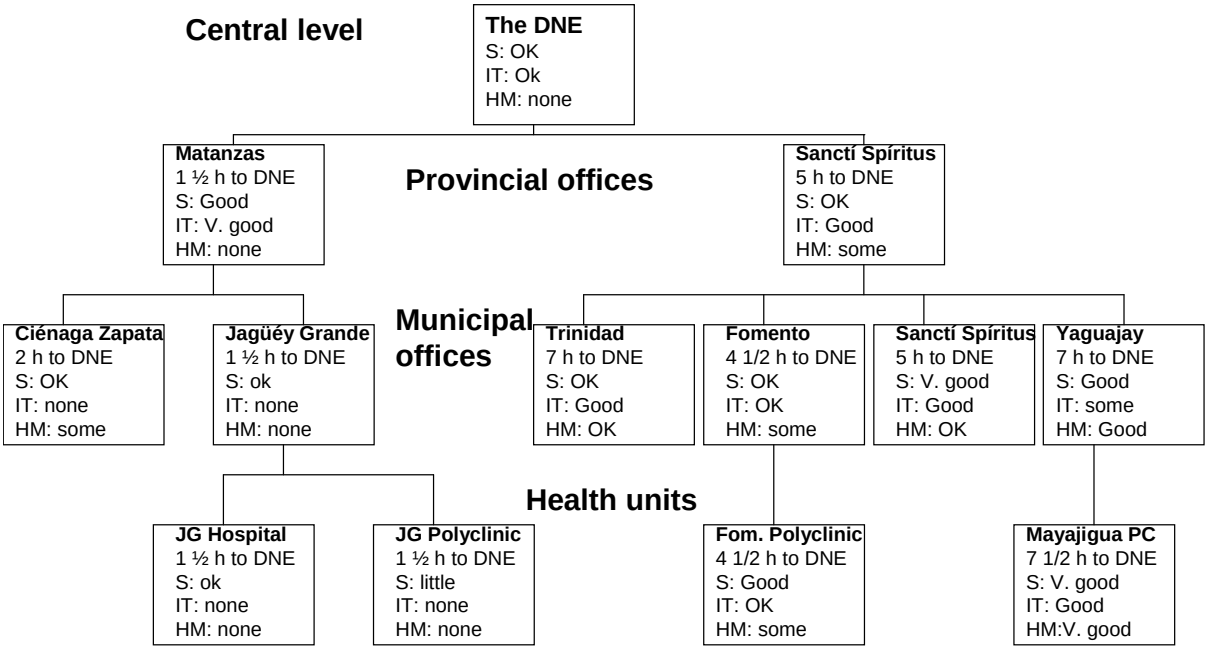

Figure 38. Hierarchical view of participation in the pilot sites.

Explanation: Illustrating differences in participation in the pilot places in a hierarchical structure showing distances to the central level, S: participation of statisticians, IT: participation of IT staff or IT-skilled personnel, HM: participation of local health management, PC: polyclinic, Fom: Fomento, JG: Jagüéy Grande.

Clearly, the results of a participatory process in the different places were also dependent on the human resources, and some of the variations seen in the figure are due to differences in skills and understanding of the present health information system. However, often in places with good participation, their cooperation was due to a more local interest and commitment, as in the municipal offices in Trinidad, Sanctí Spíritus, Yaguajay and Fomento where they allocated skilled IT personnel from other sections or offices to help the statisticians.

The degree of participation with local health management, and to some extent the local IT staff was closely related to the degree of interdepartmental collaboration and integration of the human resources found at each place (ref. 7.4.4). A tendency we have seen while working at the different levels and in many different places, is that the more

rural or local-level the statistics office is, the higher is the degree of integration with the rest of the health office. The DNE in Havana does not encourage the local health statistics offices to collaborate with other departments, and prefer as little interdepartmental cooperation as possible. This fragmentation is more visible at the central and provincial levels than at municipal and health unit levels. One reason is that the local health offices are much smaller than the ones at the higher levels, and thus the health statistics offices are situated much closer to the other offices. At the national level the health statistics office has its own building, while at a polyclinic all departments have offices in the same hall. We have also experienced a tendency towards more interdepartmental collaboration at the rural and isolated offices than at the ones within easy access from Havana. This tendency towards more local autonomy in rural places might exclusively be a result of the physical isolation and thus a need for a stronger local management, but based on our experiences, we suggest that this is also related to the distance from the power and control mechanisms found in the capital Havana.

This degree of autonomy related to the distance to the power centre is a classical property of authoritarian and centralised regimes. The Chinese have an old saying that describes this situation:

"The emperor's eyes can't see further than the highest mountains"

Heeks, Mundy, and Salazar (1999) discuss the appropriateness of a participatory approach, and they present a list of properties describing contexts where the approach is unlikely to work well (ref. 2.1.3). This list could have been a description of the Cuban health system, as most properties are found in the Cuban context. So, according to this understanding a participatory approach is unlikely to work well in the Cuban health system. Based on our difficulties described above, we can agree that these types of contexts are at least problematic for a participatory approach. However, we have experienced a great variation in the success of a user-participative approach in different pilot sites, and argue that there is a need for taking these variations into account.

Based on our findings from a Cuban context we would like to build further on Heeks, Mundy, and Salazar's argumentation and suggest a model for understanding participation in a centralised and hierarchical context.

Our model only considers aspects of user participation that we argue are caused by the centralised and hierarchical structure, and is not related to human skills and technical aspects of the infrastructures. This separation is of course difficult to make as all contextual aspects play a role, but still we think such an isolated view can contribute to a general understanding.

Important properties of a good participatory process in HIS development:

- Access to meet the right users
- Involving a variety of stakeholders
- Confident users, some local autonomy
    - Local will and possibility to participate
    - Interdepartmental collaboration
- Users with self-interest and commitment

Constraining factors to participation found in centralised, hierarchical systems are respectively:

- A fragmented hierarchical structure, several command lines, many sections, little interdepartmental collaboration
- A strict political system with focus on monitoring, control, and punishment of dissidents. Not a culture for rational scepticism or questioning decision-making.
- Centralised decision-making, nationally defined ISs for central use, institutionalised local health workers
- No emphasis on local decision-making and local empowerment

Variables that controls the constraining factors:

- Hierarchical distance to the power centre
- Physical distance to the power centre

We present a model (Figure 39) that shows how the success of the participatory process measured by the properties given above, will vary due to a variation in the effect of the constraining factors presented when moving down the hierarchical system or physically away from the geographical power centre.

Variation in successful user-participation due to hierarchical and physical distance to the power centre:

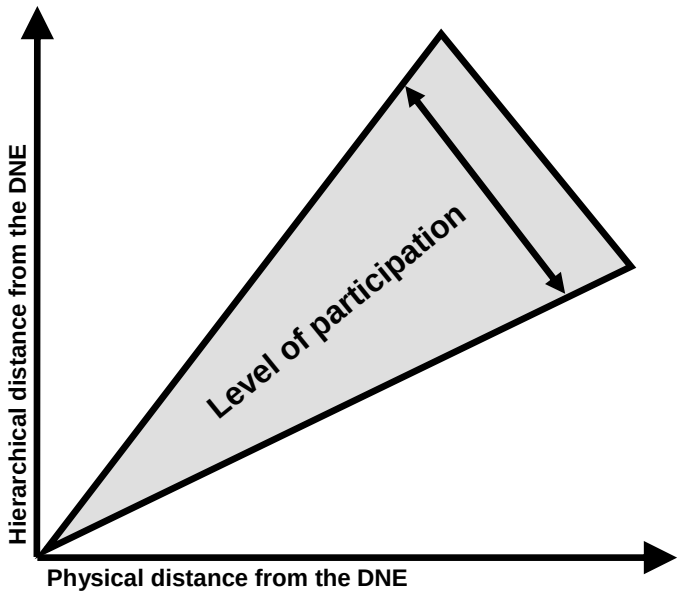

Figure 39. Variation in participation in our pilot sites

Explanation: The variation expressed in the integral illustration is based on hierarchical and physical distance to the DNE.

Need for adapting the approach – focus on top-level support

Participative design and evolutionary prototyping are widely understood by IS researchers as context sensitive approaches. However, despite being context sensitive, the methods clashed with the Cuban context. Our approach focusing on local level involvement did contribute to a more context sensitive local prototype, but it was stopped because it was not sensitive to the decision-makers at the national level. Without top-level support we could not continue the local approach and had to change to a centrally focused top-down development strategy.

Heeks, Mundy, and Salazar (1999) explain context sensitivity as matching the conceptions of the new system with the reality of the context where the system is implemented. This conception-reality gap can be closed with the use of context sensitive methods like prototyping and user participation. However, it is just as important to make sure that the development methods themselves not represent a conception-reality gap, meaning that conceptions inherent within the methods need to be sensitive to the reality where they are implemented.

When developing and adapting a HIS in Cuba we closed the conception-reality gap concerning the *content* of the HIS, but we did not close the conception-reality gap concerning *how* the HIS was developed, and as a result the local development process was stopped.

In order to apply a local participatory approach in a Cuban context, the approach needs to be adapted and fine-tuned just as the information system itself. In the centralised Cuban health system a political support from the national level is necessary to get anything done. In some way we should have managed to get support at the DNE to involve the local levels in the process, only then could we have achieved a sustainable local-level participatory approach.

When it comes to obstacles to local participation, the centralist and bureaucratic structure in India is to some extent similar to what we have experienced in Cuba. In their analysis of the HISP project in India, Braa, Monteiro, and Sahay (2003) argue that local participation in India needs to be supported and sanctioned from the top level due to the centralised hierarchical structures.

The top-level decision-makers at the DNE did not see the need for a HIS to support local use of information, and they did not have much experience and knowledge from developing systems that focus on local use of information.

Given these quite different views on health information and approaches to developing HISs, how could we have proceeded differently to achieve a more sustainable systems development process?

An approach could have been to put more emphasis on a central-level knowledge transfer of systems development theories, with special focus on the social systems perspective and context-sensitive methods. A common understanding between the two collaborating parts concerning development strategies would have been a promising point of departure for a systems development process. However, given the current political conflicts and the interest at the DNE to strengthen the centralised information

systems, it is hard to see how they could have agreed on a strong focus on local information use.

Looking back at the project, a more likely successful approach would have been to let the DNE take more initiative on how to develop the new HIS to reduce conflicts and achieve crucial top-level support. In such an approach we would have had to seek compromises between the HISP-approach and the needs of the DNE, and develop an adapted Cuban HISP-approach with the needs of the DNE as a point of departure.

Such a compromise approach would have emphasised on developing a computerised system to strengthen the present HIS and its vertical information flows, and an empowerment of local health managers would not have been a prioritised objective. This is similar to the DNE led approach we followed in the second phase of the project (ref. 7.4.3). However, such an approach is better than an approach that is terminated after three months, and in the long run this approach could also support local work processes and local health management. The software permits local analysis and use of information, and given computers at the local level, even a system designed to tailor national needs would provide possibilities for local use of information. In this way, a central-level approach that would have been much easier to support for the DNE management, could also meet the objective, though more indirectly, of supporting local use of information. This approach will be discussed in more detail in section 9.3.

Summary

We have seen that the systems development process has been turbulent and influenced by political constraints. We started the project with a locally focused approach with strong involvement of the local level. However, this was soon stopped by the central decision-makers and changed to a more centralised approach focusing on the top levels. We have outlined both differences in understanding of systems development and political needs for central control, as reasons for this change. Furthermore, we have analysed our experiences with applying a participatory approach in the Cuban setting and put forward some tendencies; participation appears to be more fruitful at the local level than the central, and also more rewarding at rural places away from the power centre than in pilot sites close to the capital. Finally, we concluded that the approaches to systems development applied in the project were insensitive to the Cuban context, and need to be adapted in order to be more appropriate. A suggested strategy is to focus on central level needs and be more sensitive to the centralised system.

9.1.2 Approaches to health systems reforms and HISs

The South African HIS is strongly influenced by the primary health care approach as laid out by the WHO Alma Ata-declaration and subsequent documents emphasising decentralisation, inter-sectoral collaborations, active and local use of information, and equity in health. In the following we will discuss to what extent Cuba follows these recommendations, and how an HIS based on the South African model can be developed within the Cuban context.

The discussion will be based on our contextual findings from the Cuban health system, relevant literature on health information systems (ref. 2.3) and the HISP philosophies and ideas on health information (ref. chapter 3). In order to analyse the adaptation

process needed we will draw upon relevant theory on organisational informatics (ref. 2.1.2).

In the years after the Alma Ata declaration two different views on PHC developed (ref. 2.3.2), namely the selective and the comprehensive PHC approach. The Cuban health system belongs to the selective PHC camp. In Table 10 below we compare the South African and Cuban way of applying the PHC approach, and the following discussions will be based on this comparison.

Comprehensive PHC approach embedded in South African HIS (the HISP-approach)	**Cuban selective PHC approach**
Decentralised (2.3.2) - Health services - Decision-making - Preventive health care	Health services decentralised Decision-making centralised Mainly central-driven curative health care Specialisation, specialised curative care
Horizontal and integrated (2.3.2) Horizontal Information flows Interdepartmental collaboration	Vertical and fragmented Information flows vertical and bottom-up Lack of interdepartmental collaboration
Health District focus (2.3.3) District information centre integrates all health information Unified and co-ordinated district health office	Central focus District health statistics office controls all information flows Several separated sections inside the district health office, central plans from "mother office" within same department more important
Action led IS (2.3.3) Data collected for decision making	Information as signal and symbol Data collected for monitoring and publications
Local adaptation (2.3.3) Few central standards, encouraging local adaptation Each local office develop their own set of local standards	Central standards No encouraging or flexibility to local adaptation Some local offices develop local standards anyway

Table 10. HISP vs. Cuban context on HIS philosophies

Ambivalent adaptation of the PHC approach

The Cuban health system reflects an ambivalent adaptation of the PHC concept; while it has extremely decentralised health services and among the best medical coverage in the world, the decision-making in health management remains in the hands of a few. Article VI outlining the PHC concept in the Alma Ata declaration states:

"*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.*"

The family doctor system implemented in Cuba (ref. 5.5.4) is extremely decentralised concerning the objective to bring health services to the community. One general practitioner and two nurses serve a small neighbourhood of 500-800 people from a small family doctor office. This system was implemented in the eighties to shift from the model of specialist care to a more WHO aligned generalist approach. However, there are still a strong focus on specialised services and at as low as the working group level there is a team of specialists serving a population of about 10-15 000 people. This specialisation of health services at the lower levels is similar to the specialised medical system of the former Soviet Union, an contrary to the PCH approach where specialised services are found at the higher levels and organised with a high degree of coordination and interdepartmental collaboration.

Cuba has put an extreme amount of resources in the task to bring health services to the community, and has succeeded in this approach, though not in the most cost-effective way.

Thanks to the excellent health service coverage of the family doctor system, Fidel Castro received a Health-for-All Gold Medal from the WHO in 1998. The award however, says nothing about decision-making and power distribution in the Cuban health system. Officially, at least structure-wise, the municipal and provincial assemblies direct the municipal and provincial health offices, but the reality is that all important decisions are taken at the central level, and most likely too a large degree by the President himself.

An important part of the Primary Health Care approach following the Alma Ata declaration has been decentralisation of decision making and health care delivery as well as a more general empowerment of the local level. Decentralisation of the HISs to support decision making and management at local levels is following from this general approach (Opit 1987 and Sandiford, Annet and Cibulskis 1992). Contrary to these ideals, the centralised Cuban health information system (ref. 5.5.6) serves more as a tool for central monitoring and control than a provider of local information. Despite its central focus, the Cuban HIS is a result of the work of a whole armada of local-level statisticians, and these human resources together with the well-functioning reporting structure, represent an enormous potential to provide useful information also to the local level.

Information as signal and symbol

The global introduction of a PHC model and a focus on the local levels were followed by an increased need for providing information to support local actions (Opit 1987). Action-led systems that only collect the data that is needed for appropriate management and appropriate decision-making were proposed to meet these local needs (Sandiford, Annet and Cibulskis 1992).

The Cuban health information system is a made up of 67 subsystems with totally thousands of data elements, and their main intention is to provide the central level with data for monitoring purposes. Most of these data are not used in local-level decision-making and is just reported up to the national level where due to the huge amount of data and lack of good computerised analytical tools, it is not possible to use all of it in

decision-making. Due to the high level of aggregation, these data are not even potentially appropriate for local use.

Following the theories of Feldman and March (1981), this data gathering at the central level leads to the conclusion that information is a strong symbol in Cuba, and that it symbolises a commitment to rational choice. The impressive data collection signals that the Cuban health system is taking the process of gathering information for decision-making seriously.

The Cuban use of the infant mortality program is a good example on how health data become signal and symbols. Among the most important parts of health information system in Cuba is to report incidents of infant mortality on a daily frequency by phone from all health units in the country, via the municipal and provincial offices to the DNE. This illustrates two things:

First, these data have no relevance to local decision-making, as there is no way you can do useful analysis on a day to day basis on incidents that might happen once or twice a year in a municipality. This clearly states that the daily reporting of infant mortality is done exclusively to please the central level. Daily reporting in health information systems is normally used in surveillance of communicable diseases i.e. measles where rapid response is needed.

Second, it can lead to the understanding that data itself is more important than decisions. Collecting these data every day has no useful purpose other than to signal the strong commitment to health in Cuba on the area where they are amongst the best in the world. Cuba openly boasts of its achievements in infant mortality, as seen in this speech by Fidel Castro in May 2003 at the University of Buenos Aires:

"*At the same time, the infant mortality rate in our country is below seven per 1000 live births during the first year of life; last year it was 6.5 , the year before it was 6.2, and we plan to lower it even further. We did not know if it was possible to reduce infant mortality to these levels in a tropical country*." (Castro, 2003a)

Earlier the same month during a speech in Havana:

"*Infant mortality has been reduced from 60 per 1000 live births to a rate that fluctuates between 6 and 6.5, which is the lowest in the hemisphere, from the United States to Patagonia.*" (Castro, 2003b)

Another story that illustrates the symbolic effect of the infant mortality rate is from a recent diplomatic reception in Havana; During a speech, Fidel phoned his Health Minister three times to get the most updated figures on the infant mortality rate!

The infant mortality rate is also displayed at the opening page of the website Infomed, as shown in Figure 7 (section 5.4.5), and Child (up to 5 years) Mortality Rate is one of the axis in The World Health Chart (Figure 8, section 5.5.1).

The infant mortality rate is also elementary knowledge for all foreigners attaining international brigades or public health courses in Cuba. One of the authors attained such

a brigade prior to the research, and was reminded about the infant mortality rate at each discussion and each visit to health facilities.

We must not forget that Cuba *has* an impressive infant mortality rate, and given its resources it is an incredible achievement. However, as this is an important WHO and UN indicator on poverty and standards of living, a national pride, and represents a moral victory over the US, the almost obsessive reporting is a symbol of the great Cuban health system.

The preventive medical reason for daily reporting of infant mortality is overshadowed by two important factors. *First*, it is used internationally to promote Cuba's achievements in health. *Second,* it is used nationally to create unity, by highlighting this achievement.

Infant mortality is just one of thousands of data elements that are collected daily, weekly, monthly, quarterly or yearly. The main purpose of most of these data is to end up in health statistics publications. The DNE produce a comprehensive annual yearbook as well as many smaller leaflets and reports. Some is used internationally as promotion or in reports to the WHO, the PAHO (Pan-American Health Organisation), or the World Health Chart.

Information philosophies reflected in routines of the health information system

The centralistic nature of information use is reflected in the routines of the current health information system. Routine health data is aggregated to the higher levels (ref. 5.5.6) and the local meaning of the data is lost in these reporting routines. At the national level, only provincial aggregates are received, and similarly at the provinces there are only municipal aggregates. This aggregation indicates that local information use is not prioritised, and the whole apparatus involved in the information system; the different forms, the statisticians at all levels, the frequencies, every part of it indicates that the health information system is a tool that serves the central level.

The direction of the information flows in the Cuban HIS help to strengthen the picture that the HIS is a central tool. The dominant information flow is upwards within the health statistics department, and there are minimal horizontal information flows, indicating a lack of interdepartmental collaboration. The local management does not benefit from the extensive data collection that takes place just down the hall at the local health statistics office. An important part of the comprehensive PHC approach is to integrate all information in the health district (municipality in Cuba) to reduce fragmented reporting in many different programs. Cuba has integrated all data reporting within the health statistics offices, and this department is an impressive organisation. The problem with the Cuban system regarding local information use is that information to a large extent does not leave the health statistics department and hence is not used by the sections that need information. All family doctors report to the health statistics office on a daily basis, but from the statistics office and to the polyclinic management that supervise the family doctors there is only limited reporting. This fragmentation of the health system must be decreased, and the horizontal information flows increased accordingly in order to develop a Cuban HIS based on the ideas of the South African/WHO model for HIS.

Central standards, central information use

The South African HIS has defined a hierarchy of standards (ref. 3.2) to secure both a national dataset with the required standards for data reporting that apply to the whole country, and a local flexibility to develop local standards that are tailored to local needs for information. This hierarchy has a pyramid structure, with the smallest set of standards at the top of the pyramid, the national level, and the largest set of standards at the bottom, at the local health facility level, following an information logic that argues that the local levels need more information for decision-making than the national level.

The Cuban HIS does not reflect such a pyramid structure, it is more like a block (Figure 40), a structure we have called the *Centralised Data Block*. The national level has defined a large set of national standards that all levels must follow, and there is no room for local flexibility to make additions to these standards.

This perspective on information is opposite to what HISP promotes, and led to a different prioritising of coverage (ref 9.1). While we argued for scaling up regarding municipalities and health units to support local use of information, DNE saw it as more important to scale up regarding data elements, as the first essential dataset did not comply well with the existing system.

As we discussed in section 9.1.1, there is a relationship between the aggregation level and the size of the datasets. Table 11 shows how the amount of computers and the size of datasets facilitate disaggregated data. It is based on (ref. Figure 18, section 7.2) showing the logic of dataset sizes. While we argued for revised smaller datasets, scaling up to more computerised municipalities and health units, DNE focused on their need to collect the full set of national standards, thus seeing scaling up as expanding the datasets. This led to the development of the hospital database prioritising to equip more provincial offices with computers (ref 7.4.3 and Appendix B).

	Maximum datasets	**Revised, smaller datasets**
Computers to health unit	Feasible	Better quality, more adapted to the municipality
Computers to municipality	Too much data, must aggregate, lower quality	Feasible, better quality

Table 11. Scale (number of computers) and the size of datasets trade-off

Eplanation: the relationship between the level of scale (number of computers) and the size of datasets

This use of standards reflects how centralised the Cuban health system is, and support our argument that the HIS is developed to support central needs, and thereby ignore the local needs for information.

The Centralised Data Block (Figure 40) is a typical property of a data-led system (ref. 2.3.3), where data becomes and end in itself, gathered for its sown sake (Sandiford, Annet and Cibulskis 1992).

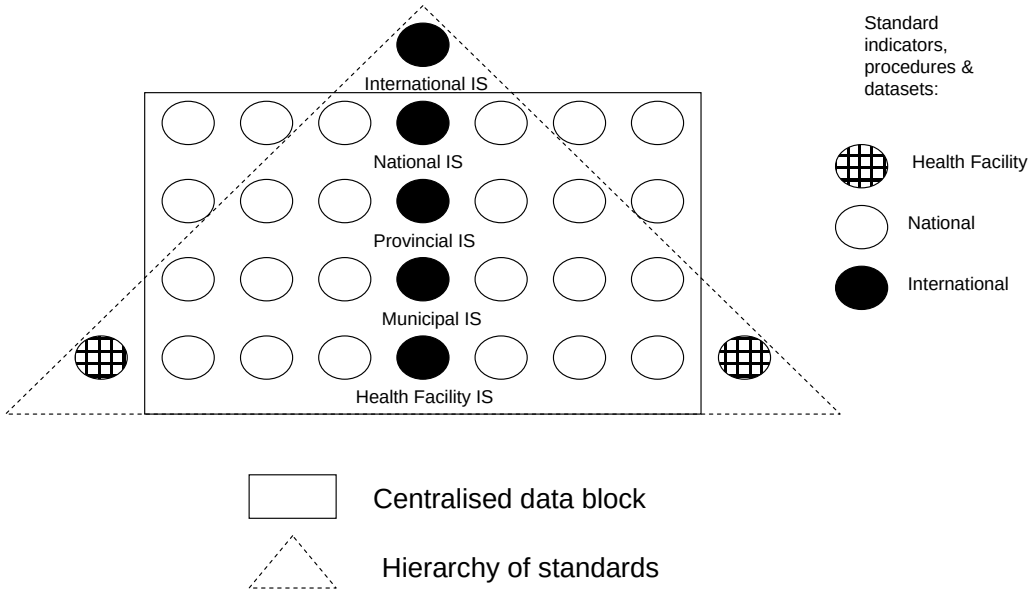

Figure 40. The Centralised Data Block

Explanation: the Centralised Data Block shows how the national standards are the one and only official information system. The local procedures outside the defined national system seen at the health facility level, illustrate local initiatives to improve local use of information.

Still, even if the local levels are ignored in this central reporting tool, compared to South Africa where the local level has the largest datasets, the lower levels in Cuba have the same amount of data. A result of the huge datasets reported to the national level is that the local levels collect all the data they would need for local decision making. The big difference is information use, and in Cuba the data is collected by the enclosed statistics unit and reported upwards without much sharing of information to other sections at the same level. The fact that all these data are collected at the local level and that there are well educated statisticians processing them and ensuring good data quality, represents a potential in local information use, the challenge is to redevelop a system that facilitates local use.

During our fieldwork out in the provinces we experienced that some of the local health managers despite the national intentions to ignore local information, made use of the local health statistics office and the potentially good local information found there (ref. 7.4.2). At the polyclinics we met directors and working group managers that made special requests for information at the local health statistics office. These internal and locally invented reports consist of the most important data for local management, data that are spread over many different national forms, but here also gathered on just one form to report to the local management. This is in line with the South African HIS, tailoring to local needs, and with flexibility to local adaptation and action-led reporting. The present HIS in Cuba does not encourage such local initiatives, and as to symbolise that, these locally invented forms were called *datos negros*, black data (see Figure 40).

These local inventions to enhance local health management show that there are human resources at the local levels to manage a locally driven HIS, an important infrastructural factor developing a HIS to support local health management.

The Municipality, the Cuban Health District

The WHO suggested a health district model to implement the objectives of primary health care (ref. 2.3.2). The Cuban counterpart, the Municipal health office fulfils many of the requirements of a health district. The municipal health office administers all the local health units, and integrates all information flows within the municipality. With its polyclinics, working groups and family doctors it fulfils in an impressive manner the requirement to provide health care to all of the municipality's population. An important part missing is the power to administer and manage the health care in the municipality. This power is restricted to follow orders of the central levels and there is little local autonomy to manage the health care in the municipality. Closely linked to this problem is the lack of local information made available from the health statistics office. In order to implement the health district model in the Cuban municipality there must be some decentralisation of decision-making. The Cuban health system needs to shift focus from a central, to a more decentralised approach, and from what we have heard, the new health minister emphasises local use and prevention. Unfortunately, we were never in the position to interact with the new administration.

Summary and conclusions

As we have seen from the discussions above, there are some important differences between the ideas of health information found in the South African HIS and the present Cuban HIS;

- Information flow (vertical vs. horizontal)
- information use (central vs. local)
- Political reasons/ideas for a HIS (data-led, signal and symbols vs. action-led)

However, we have also seen that there are important similarities arguing that a HISP-approach can be appropriate in Cuba;

- Integrated information reporting
- Decentralised health services
- Good data quality
- Good human resources at local level
- Comprehensive data collection at the local level

The most important difference in the two countries concerning a PHC approach is the focus on local empowerment, which is not supported in Cuba. The South African model for PHC is not appropriate for Cuba as it is far too decentralised to be of any interest to the decision-makers. However, Cuba has the resources and many pieces already in place to adapt parts of the South African model, such as an increased local use of information and a more preventive care-focused and action-led information system. In order to move in such a direction there is need for a piecemeal development process that first of all is

sensitive to the decision-makers. In the next section we outline such an approach in more detail.

9.1.3 Organisational change and political brokering

The discussions on approaches to systems development and HISs above clearly illustrate that this adaptation process has been far more than just a technical process. The development has been turbulent and especially affected by the political aspects of the Cuban context that have overshadowed the more the technical issues. To understand the adaptation process and analyse its possibilities and limitations, a social systems perspective on information systems is necessary (Kling and Scacchi 1982, Walsham 1993, Kling et al. 2000).

The two sub-discussions on research objective 2 both argue that the context is important, and in fact directs the development process. Two main conclusions on the HIS development process can be subtracted from the previous discussions;

1) To develop a sustainable system in Cuba there is need for commitment and support at the top level.

2) The development must follow a compromise approach facilitating a softer adaptation of the HISP-approach that is acceptable to the decision-makers.

Such a compromise approach, despite being sensitive to the decision-makers in the Cuban health system, will involve some degree of organisational change.

Applying an analytical framework for IS and organisational change

In order to understand such an organisational change process we will use an analytical framework presented by Walsham (1993, see section 2.1.2). This analytical framework can help to illustrate how the different aspects of the Cuban context play a role in the development and change process, and to illustrate possible strategies for change. The framework consists of the four components *content, social context, social process* and a *context/process linkage* (ref. 2.1.2).

As an example of how content has influenced the development, we have seen that properties of the new information system pushing a local empowerment process have created conflicts in an organisation that is not ready for such a decentralisation.

The local context, represented by the Cuban health system and the health statistics department has definitively affected the development and change process. We have seen how the Cuban infrastructure, with skilled personnel and structured information handling at the local level, supports a well functioning HIS, however, the traditions of data-led and centralised information systems and top-down development approaches have impeded a bottom-up approach focusing on local use of information.

Cuba's special position in the international community has made the global context an important factor in the development process. We have described how the U.S. embargo has affected the access to software and hardware, which contribute to the scarce computing resources in Cuba, and complicated the donation of equipment. Furthermore,

the aggressive U.S. led war on terrorism that escalated after the terrorist attacks in New York September 11 2001, has been threatening to the Cuban government (ref. 5.3.4), and led to an intensified domestic campaign to protect the revolution and clampdown on dissidents. The drastic political change in the ministry of health that affected the political support to our project, might have been a reaction of the pressured political situation. Furthermore, foreign involvement was increasingly being restricted and controlled as a consequence of this hard political line, which affected the project by limiting the Norwegian participation in Cuba (ref. 6.3.1).

In the following we go in more detail on the discussions of the two associated conceptual elements of social process; politics and culture, as well as on the context/process linkage.

Information as power in a centralised HIS

To understand the resistance to change found at the central level it is useful to analyse how important information is to the power balance in the health system. We have argued that information is a strong symbol in the Cuban health system, and pointed out how important it is to the central level. When promoting decentralisation of information use and decision making, we challenge the power structures of the Cuban health system. Kling (1980) points to the intra-organisational distribution of power as a main contributor to resistance, arguing that the actors loosing power as a consequence of change will resist, while the actors gaining power will welcome the change. By designing a HIS to support information use at the local level in cooperation with local stakeholders the DNE in Havana would have to share the "power of information". Local levels would be involved in defining data collection, information flows and use, while the central level would have to delegate many of the monitoring and decision-making tasks to the lower levels.

Furthermore, the DNE plays an important role in the Cuban health system in the way that they have control of all health information. With little interdepartmental information sharing at the lower levels the DNE becomes the main distributor of health information. All other departments, including the minister's office get their information from the DNE, and the national director of the DNE becomes an important power figure in this vertical and fragmented health system. While there are totally 22 national directors below the minister (ref. 5.5.4), the national director of health statistics is among the few who participate in top-level meetings with the minister and Castro. Adding to this monopoly the symbolic values of health information, the DNE is in an especially powerful position.

By implementing a HIS to support information sharing at the lower levels, other departments will get easy access to health information down the health system, and the DNE management will loose their powerful information monopoly. While the new MINSAP administration has marked a shift towards more focus on local use of information and preventive care, the project was controlled by the DNE who had no interest in such a change. Maybe we could have got more political support by working directly for the minister than we got at the DNE, which unfortunately for the project saw their special position threatened.

The hierarchical power holds back innovation and resists change

The authoritarian Cuban regime and the centralised control and monitoring structures create a culture of cautiousness. In the strict politically controlled environment there is no room for dissent, and those who strive to get a position higher up in the hierarchy wisely comply and do not stick out in any way.

There is one man at the top, Fidel Castro, and each person directly under him has been loyal to the Communist Party and worked hard for many years. This person's status can change in matter of weeks, as the example of the former Minister of Public Health and his administration (ref. 6.2.3). In the struggle to please the level above people are cautious not to become a dissident in any way; as a central-level person told us:

"When the beard on the man next to you is on fire, you start protecting your own".

This sense of carefulness and tactical cautiousness applies to all levels, and also the provincial and municipal directors are careful not to "stick their heads out". As long as you do what you are told, and do not question the present system or promote change in any way, you are most likely safe.

A way to be more careful is to increase control over the situation, and to top-level managers, control is very important. As discussed earlier, this prevents local empowerment as delegating power and responsibility means increased risks and less control. This cautiousness hampers innovation as every change is related to something insecure and people under pressure are not willing to take such a risk.

In addition, this strong respect for the hierarchy can restrict the support for change at lower levels. As discussed, people hold their opinions for themselves, and there is no tradition for initiating change from the bottom of the hierarchy. People expect change to be facilitated from above, and thus they comply with the level above instead of actively seeking improvements themselves.

Structuration theory applied to understand the difficult change process

Giddens' structuration theory (Giddens 1984) can be useful to understand the constraints to change we have discussed above, as well as to provide an understanding of how these constraints can be overcome and change can take place. Giddens' theory (see section 2.1.2) proposes a duality of social structures, arguing that the structures both constrain and enable change. The linkage between context and process is provided by the use of three modalities, ***interpretative scheme***, ***facility*** and ***norm*** (Walsham 1993) as illustrated in Figure 2 (section 2.1.2) We will no apply this theory to 1) understand how the present system is resistant to change, and 2) develop a strategy for change.

1) Structural resistance

Using Giddens' structuration theory as applied by Walsham (1993), it becomes clear that the health information system in Cuba reinforces itself and reconstructs the centralised and hierarchical social structures in which it operates:

The present HIS can be seen as an ***interpretative scheme*** communicating the meaning of the system; to provide the central level with information to monitor and control the

lower levels. This meaning, which has been communicated since the revolution in 1959, is well institutionalised among local level health workers and managers. The Cuban understanding of an HIS as a centralised and data-led reporting tool is the representative meaning at all levels in the health system. Thus the Cuban HIS with its centralist properties, reinforces this meaning and the structures of the centralist state where the system exists. This ability to reinforce the social structures is supported by a similar study in Mongolia; Braa and Nermunkh (1997) state that the Mongolian HIS is "structurating" the health system reproducing the social structure of the previous centralist planned economy.

The Cuban HIS understood as a control and monitoring mechanism becomes a ***facility*** that the central level uses to exercise its power. The power inherent in a monopoly of information and the control of the system, which is the case at the DNE, helps to strengthen the centralist structures of domination. The importance of this information and the power it represents have been well covered in previous discussions. The HIS is the tool that provides this information, and thus becomes a powerful facility used to strengthen the disempowerment of the local levels. Braa and Nermunkh (1997) report similar experiences from Mongolia:

"Thus, the information system remains a facility with which only the higher levels of management utilise their power, and it thereby contributes to the ongoing reproduction of the centralist and top-down social structures of domination."

(Braa and Nermunkh 1997 p.13)

Lastly, the HIS encapsulates ***norms*** and values which maintain the legitimation of the system. These norms and values are embedded in the routines and structure of the HIS, institutionalised over a long time and legitimating the strong focus on specialised and curative health in the HIS from a central management base. The strong symbolism of the use of indicators reported in the HIS as described in the case of infant mortality, helps to reinforce these norms and values related to the HIS, which are well established all over the country at all levels. The health sector is the most important symbol of the success of the Cuban revolution and is used actively in sustaining Cuba's image internationally. Health information (e.g. information on infant mortality rates) is therefore seen as a crucial state asset. Again the Mongolian health system with its Soviet legacy shows similar properties:

"The information system communicates the norms and values of the previous centralist planned economy and is thereby reproducing the old social structures of legitimation."

(Braa and Nermunkh 1997 p.13)

2) A strategy for change

Giddens' duality of structures argues that the new HIS playing the role of the same three modalities can enable for change in the Cuban health system. Analysing a similar process in Mongolia, Braa and Nermunkh (1997) suggested a cultivation process as a design strategy for change. The idea was to apply a slow and incremental bottom-up process to cultivate the philosophies of the HISP-approach into the routines and ideas of health information that were already in place. As a cultivation process is concerned with shaping what is already in place (Hanseth 2000, Dahlbom and Janlert 1996, Braa 1997), a bottom-up strategy empowering the local levels would not be a cultivation process in the centralised Cuban health system, as such an approach, as we have discussed in

section 9.1, is insensitive to the Cuban context. Understanding the present HIS as an installed base, a design strategy must focus on building on the resources and processes that exist in the system (Hanseth and Monteiro 1998), as opposed to constructing something new and radically different.

A cultivation strategy for developing a new HIS in Cuba must focus on the present HIS and the needs of the decision-makers at the central levels. The new system must be an improved and strengthened version of the old, and represent a useful system to the top-level that can obtain full support and commitment. The design process must be build on strong cooperation with the central level and be sensitive to their needs. This way of compromising the HISP-approach to the centralised Cuban needs is a brokering process where the important objective must be to develop a sustainable system, hence with top-level support. Cultivation provides the flexibility and improvisation necessary to enable such a brokering, and to adapt to local needs. While bottom-up was a suitable cultivation process for a similar development in South Africa, a cultivation focusing on the top-level seems more appropriate in Cuba.

The comparison between the HISP-approaches for HIS and the Cuban HIS in section 9.2 showed that there are important differences concerning empowering of local level management and local use of information. It may seem contradictory for a HISP team to develop a new system in Cuba that only strengthens these differences and supports the present centralised health information system. However, we believe that a computerised HIS developed with the DHIS tool, even though following a centralised design approach, can cultivate local information use.

Implementing a new computerised HIS at the local level represents a decentralisation of computing resources and tools for analysis of information. The computerised HIS will enhanced analysis (ref. chapter 1) and thus a more effective use of information to the local levels. The architecture of the software provides disaggregated data (ref. 7.1.1) to the local levels without changing the reporting routines at the top level. While the new system will look like an exact, though strengthened copy of the old paper-based HIS to the central level, it will provide a huge difference to the local levels concerning analysis and use of information. The local levels can start to use the analytical tools and produce locally useful information facilitated by the new computerised system, and there is a chance that the local health managers will get interested and slowly establish new and enhanced local routines for information use.

We have argued that the Cuban health system has a huge potential in its local human resources that the present centralised HIS not fully utilises. By providing disaggregated and useful information together with the tools for analysing them, the new HIS would cultivate and make much more use of the local human resources. The polyclinics and municipal offices would have a powerful analytical tool to support their use of “black data” (ref. 9.1.2), and the demanded reporting upwards would be facilitated in a more effective manner. To the top level this system would be a strengthened and more effective version of the present system.

Using Giddens’ terminology we can say that the new HIS would enable new possibilities of both central and local use of information, and thus act as an ***interpretative scheme*** slowly changing the structures of meaning towards a support of an action-led HIS, following the PHC-approach with increased local use of information.

Furthermore, just by the presence of computerised systems at the lower levels, the information monopoly of the DNE can be weakened due to the likely increased information sharing to other departments at the lower levels. The computerised HIS can then act as a ***facility*** that the local levels can use to enable local empowerment, which is to some extent shift of power. This shift of power can change the structures of domination, and gradually the social structures of domination begin to support decentralised information use and decision-making.

Building on its growing support and the enhanced local decision-making, the new system can establish new ***norms*** and values on how the PHC concept could be applied in a more decentralised manner. These growing norms and values supporting the HISP-approach for HIS can eventually change the social structures of legitimation, thus achieving an acceptance at the higher levels. In doing so it further strengthens the support for local information use and a more decentralised health management structure.

As an example of such a piecemeal cultivation process we can mention the "DHIS"-copy of the *Movimiento Hospitalario* (hospital patient-flow system) subsystem developed in the last phase of the project (ref. 7.4.3). It is a database designed at the central level based on central-level needs, but it also offers significant improvements to local level management; enabling quality analysis of disaggregated data to local hospitals and provincial offices. Using the DHIS database to implement the hospital system instead of the paper-based or the old FoxPro variants means an enhancement to local management, but as an exact mapping of the other variants into a DHIS database, it promotes no change to the DNE concerning the meaning of the sub-system. The fact that the system is not representing a "negative" change to the central level has been crucial in order to get central support. However, there are likely to be side effects, such as an improved local analysis and an empowerment of the provincial level and the local hospital managements. What makes such a cultivation process achievable is the fact that it is not imposed as a change process to the DNE, instead it is a side effect of a system that is designed to strengthen the present centralised routines and processes, thus on shaping and evolving the installed base (Hanseth 2002).

Summary

We have argued that information is power in the Cuban health system and that the DNE, as the only provider of health information in the centralised and fragmented health system, has a powerful and important position.

Furthermore, we have argued that the strong hierarchical and authoritarian structures represent an impediment to participatory approaches and innovation.

Giddens' duality of structures emphasise that social structures are both constraining and enabling. We use this duality both to analyse impediments to change ("constraining") and to outline strategies for how changes may be achieved ("enabling"). A change strategy needs to be piecemeal and build on the systems already there, the installed base. Political support and the needs of the decision-makers at the central levels are crucial in any viable strategy in Cuba. Despite the centralised focus in Cuba, strategies should also address cultivation of information use at the local level. Decentralisation of computer resources enables local use of information.

9.2 A technical evaluation of the software (DHIS)

Here we will address the fourth aspect of research objective 2; database tools. In the discussions above we have suggested a flexible and adaptable approach that is sensitive to the information infrastructure that is already in place. Such an approach demands flexible software that can support the context-sensitive design strategy of cultivation. We chose the DHIS tool to develop an HIS in Cuba, but is the tool flexible enough to support the needs of the Cuban health system and the proposed strategy of cultivation? In the following we will discuss our experiences with using the software in a Cuban context, and outline some future improvements that we argue will increase the possibilities of a successful HIS development in Cuba.

Prototyping strengths of DHIS

The software offers a great sense of flexibility that supports an evolutionary prototyping development method (ref. 9.1.1). Especially concerning the unstable political situation the ability to easily change the design or develop new databases was crucial to our design process in Cuba. Political decisions often led to entirely new databases to be made (ref. 7.4.3), lack of resources led to specialised structures and new features, like one-page reports to save paper. As these constraints could shift from place to place and week to week, the DHIS was put on a hard test, but catered for most of these needs. The software support to set up new databases or apply changes rapidly was of great importance in our participatory approach, as we could implement suggestions, show and discuss it with users, and then change the database again the very same day.

Translation of the graphical user interface to Spanish

The multilingual property of the software (ref. 7.1.1) has proven to be crucial in Cuba, as an English version would have been an impossible solution due to language problems. Without the easy translation module, a hard-coding of a Spanish version would have been extremely difficult and time-consuming due to limited resources and the amount of technical insight and familiarity to the software such a task would have demanded.

In version 1.3.022, the last version installed in Cuba, there are 2280 text strings, some of which are several paragraphs long. The hard coding of these strings would be a tedious process, almost impossible for the Cuban project. Furthermore, if the translation had been hard coded, new versions could not have been implemented as the translation process had to be done all over again.

A problem related to the translation process was the issue of making the Spanish text strings to fit in the predefined boxes and buttons in the graphical user interface (GUI), as the Spanish language often use longer words than English. Similar problems were reported from the translation to Portuguese, and the only solution is to hard-code design changes so that buttons are enlarged to hold the longer text strings. This is not a serious problem, as it is quite fast and easy to fix, but it illustrates some of the challenges with providing multilingual software.

As we can see in Figure 41 below, the text strings in the GUI are translated, but of course as the GUI is a Microsoft Access application, the Access' specific menus at the top of the page follow the language of the locally installed Microsoft Office package.

Figure 41. DHIS screenshot illustrating multilingual use

Explanation: The DHIS uses Norwegian strings for the user interface, since this computer is set to "be in Norway". Access still uses English strings since the Office version installed on the computer is English. The database front page is customised as defined in the Cuban data file (i.e. local database).

Problems and bugs - MS Windows complexity

Despite the strengths of the multilingual software, this language flexibility also fostered some problems. The DHIS is coded in the programming language Visual Basic (VB), and in some VB-scripts the boolean operators true or false are used. The English versions of these operators are used worldwide to provide compatibility in a globalised software environment. While running the software in a Spanish version of Microsoft Office the VB scripts using English names for the Boolean operators create problems, since the Spanish Office uses the Spanish translation of these operators, *verdadero* and *falso*. The fact that Microsoft that provides their software in more languages than any other product translated the internationally used boolean operators true and false came as a shock to the HISP developers in South Africa. With his help we managed to fix this problem by using the values 0 and 1 instead of false and true, but it took us four valuable days in the provincial office in Matanzas to find the reason for this problem that was quite difficult to see.

A similar problem with the multilingual functionality is how Windows changes the standards for numbering like the list separator when the location is changed in the regional options in the control panel. To display the Spanish version of the software a Spanish speaking location must be chosen, but then the list separator may be changed from the U.S. standard "," to a ";". The import/export functionality in the software uses ASCII text files which uses list separators, and we experienced problems with the importing and exporting when the list separator was set to ";". Luckily, the list separator can be set manually independent of the chosen location in the regional options, but at first we did not understand the reason for this problem.

The software was developed to be used as a stand alone application as opposed to a network application. This has created some problems when using the software on computers that are part of a local network and hence have limited administrational rights. At start up the software needs to read some registries to retrieve information that tells where the different data files are found on the local machine. A normal user logged on a local network does not have the rights to read these registries and this creates a

runtime error, thus it can not be started. We solved this problem by logging in as administrators or other user with similar rights, but this is not an accepted solution in a networked office environment. There are plans to make the software more network compatible in the future, and this in needed in order to keep up with the technological development.

One of the reasons for these bugs is the complexity of supporting all configurations of the Windows platform. With several versions of Windows (98, 2000, Me, XP) and Office, (97, 2000, 2002, XP), with or without several service releases and service packs, and in any desired language, there are a vast number of possible Microsoft combinations. Each and every one of these combinations is different, so DHIS must handle all of them, more than 100.

Another technical problem that took us many days to solve was not directly related to the DHIS software, but permitted us from using it. For more than a month we were not able to use the software on two of the computers at the DNE. The problem appeared to be the same as the one explained above related to the registry access rights, but for some reason it was not solved as the one above, when we logged in as administrators. For many days we debugged all the actions taken by the software trying to trace the problem, but without result. By coincidence we found out that there was an anti-virus application running on the machine that was programmed to reject any attempts to access the registries. So by shutting down this anti-virus application the problem was fixed.

Lack of documentation

These bugs described above could not be easily fixed in Cuba since there is no proper documentation of the software, and we were dependent on online support from South Africa to fix these problems. As we often were days without e-mail communication, this online support was not optimal. The HISP aims at creating a global network enabling local developers to design local adaptations, and to share development tasks around the network to improve the open source software. However, at the moment, without proper documentation of the database and the programming logic is difficult to debug problems, do improvements or develop new modules. Right now, with the poor software documentation the development team in South Africa, the only ones with in depth knowledge about the software, is overloaded with questions, requests or other supporting tasks from a growing global network.

Limitations of the DHIS

As mentioned above, there is a great deal of flexibility in the software, but there are also some important restrictions concerning database modelling. The database structures are locked to five levels and data entry is only possible on the lowest level (ref. 7.1.2). The number of levels (5) refers to the initial situation in South Africa. The decision to only allow data entry at the lowest level was basically a “political” decision to ensure that the hospitals reports through the district structure. Hospitals are generally strong units that tend to outmanoeuvre the district management teams. If they are “forced” to report through the districts, that may eventually strengthen the districts. These two design decisions illustrate how the South African context has influenced design decisions.

The development team in South Africa has planned to take away these restrictions in the next big release, but in our Cuban project we had to find workarounds to solve these problems (ref. 7.4.2 and Appendix B). The problem related to a fixed five level structure representing the health organisation was already noted in the Mozambican project, and we have been able to draw on important knowledge from the Mozambican development team. Our specific workarounds to these problems are explained in the section concerning the database modelling (ref. ref. 7.4.2 and Appendix B), and despite that these restrictions did not create any serious problems to the development process, it is clear that a full flexibility in the number of levels in the database structures as well as in data entry would have made the design less complicated, as well as signalled more professionalism to the Cuban participators.

Another limitation found in the software is related to the reporting frequency. While in South Africa routine data is always reported on a monthly basis, the Cuban HIS has daily, weekly, monthly, quarterly and yearly reporting. The first databases we designed only involved data that was reported on a monthly basis, but as discussed to scale up the project, the need for weekly and quarterly reporting had to be met. Reporting at a lower frequency than the monthly standard is quite easy to workaround, and we facilitated quarterly reporting. However, implementing weekly and daily reporting demands more complicated changes in the software to be made, and since we never scaled up, this problem was not looked into. Anyway, it was a clear that the Cubans aware of this limitation became more sceptical to the software.

Resistance due to the technical aspects of the DHIS

Drawing from Markus (1983), all the above mentioned problems and limitations contributed to resistance to the DHIS, and especially at the national level the errors were used for what they were worth instead of trying to solve them. An example is the course held in Havana September 2002. The system was installed on four machines there, but then some did not work due to the mentioned registry problem. Furthermore, the problem related to translation of boolean operators limited the features we could present in the Spanish version. Markus (1983) states that technically sound systems are less likely to be resisted than those with frequent downtime, poor response time, and that users resist systems that are not “user friendly”. The limitations in entry levels and reporting intervals were additional constraints that increased the resistance.

CEDISAP, health software production group, expressed a fear of having to change the software if they were involved in the development process. While this, and other reasons, was enough for them to decline collaboration, they would surely not be satisfied with the documentation of the system, probably leading to resistance of it.

Microsoft dependency vs. an open source platform

The software is free and open source software (ref. 7.1), most importantly meaning that it is a non-commercial product, and that it allows local developers to alter the code to fix problems, improve the software, or develop new features modules.

The economical benefits to the receiving countries of using a non-commercial product is clear and even more important when applied to developing countries. However, these economical benefits are overshadowed by the fact that the free software demands a

Microsoft Windows and Office environment. The licenses for these products are very expensive, and considering the amount of licenses needed to cover all the units involved in a national HIS, using the DHIS software becomes expensive. When the DHIS was first developed, the choice to use Windows platform was based on the fact that the majority of the health units in South Africa already were familiar with Windows.

Based on the economical aspects of using a software tool locked to an expensive Microsoft platform, it has been planned for a long time in the HISP development team to translate the software an independent platform product. Using Java scripts and a free of charge PostgreSQL or MySQL database the software can be used on any desired platform, also the free and open source Linux platform. This way the whole package would be free of charge, not just the DHIS software. However, as this is a time-consuming task the overloaded HISP development team has not been able to follow this up. Of course, with such a translation to another platform there would be a need to find a new way of supporting a multilingual module and also find a way to replace the powerful analytical functionality of the pivot tables found in Microsoft Excel. Given that these issues are solved and at least the same level of functionality can be recreated in an free platform software, there is no doubt that this would be a huge step forward for the HISP in the battle to bridge the digital divide and to empower developing countries.

As we have described above there are many bugs and problems related to all the different combinations of Windows and Office that must be supported. Platform independent software would not have these problems, at least not to the same extent.

In Cuba the Microsoft licenses represented no economical problem since the Cubans, due to the embargo, use pirate copies of Windows and Office free of charge (ref. 6.3.3). However, in near future Cuba might have to buy licenses as well due to new international laws. In addition, Microsoft has intensified the battle against pirate copies and the Windows XP system is much more difficult to pirate copy and maintain without a license than previous versions.

Need for facilitating a web-enabled DHIS

One of the reasons for shutting down the project was that a new modern system based on the newest technology is planned for in Cuba (ref. 6.2.5). These plans involve web-based application networking the reporting units all over Cuba. The idea is to build an online reporting system with a central databank that stores all data. It is an ambitious plan, but it reflects the new generation of database solutions, systems with a central server-side database and modern web-based graphical user interfaces. As discussed, the political brokering process demanded a more adaptable system to the needs of the decision-makers. To cultivate a new improved HIS in the Cuban health system we must be able to adapt to the new visions and demands of the Cuban government, and thus provide a web-enabled system. However, as we will discuss, the Cuban visions represent a certain mismatch with the available infrastructure. To develop a more sustainable system we will propose a scalable solution that can adapt to the infrastructure at hand.

Similar demands start to evolve all over the HISP network, and there is a push for web-enabled solutions based on the latest technologies. Even though many developing countries are not fully and properly networked, there is a need for providing a flexible

and scalable system that makes use of the modern infrastructures where these are in place, and at the same time is a 100% functional in less developed areas.

Besides the political aspects, there are several reasons for updating the DHIS to a web-enabled database system:

- Flexibility and scalability to use the system both as a stand-alone solution and as networked solution with different degree of distribution
- Web-enabled database applications allow for more inviting and usable GUIs with browsing and multiple windows and better graphics
- Three-tier architectures (Eckerson 1995) make it easier to modularise and thus share development over an international network
- More scalable database solutions, support for both small and very large databases
- Platform independency, enables the system to be run on any type of platform

An important feature of a web-enabled solution is the flexibility to choose the degree of distribution and networking. Today's version of DHIS supports only stand-alone databases and cannot use the advantages of a computer network. The variable infrastructures of developing countries call for a flexibility to apply both stand-alone and networked solutions within a country or a province. Where the infrastructure is in place the databases could be networked and make use of the technology and benefits of the network, and where the infrastructures are not supporting a computer network, a stand-alone version of the web-enabled system can be used. In Figure 42 the horizontal dimension shows this flexibility. A stand-alone system cannot in the same way be scaled up to a networked solution; therefore a web-enabled solution is the acknowledged way forward.

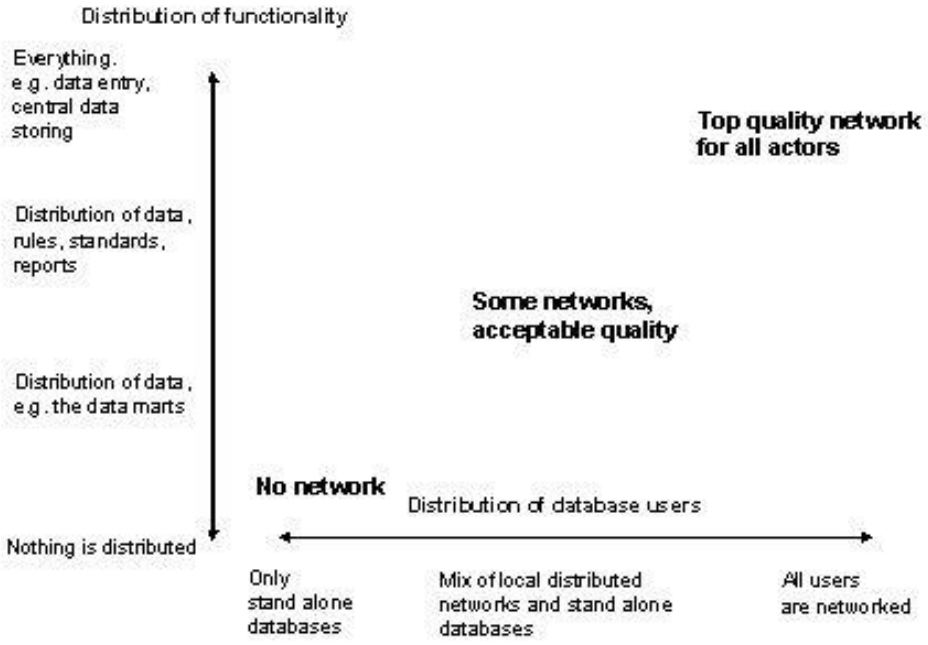

Figure 42. Distribution with a web-enabled solution

Given the variety in computer networks from modem connections on unstable telephone lines to fibre optical lines providing high speed connections and stability, the distributed solution should be flexible in the sense that it is possible to adjust the amount of functionality to share to the quality of the network. The vertical dimension in Figure 42 shows different approaches to distributed web-enabled solutions, varying the amount of functionality to distribute in the network.

A first step towards a distributed solution would be to share the data that is entered, as the data mart files (ref. 7.1.1). Given a more stable and faster network, more functionality can be distributed as e.g. validation rules, standards on data elements provided by shared data dictionaries, and customised reports. A solution where all the functionality is shared would have a central databank where all entered data is stored and a distribution of the data entry process. In such a web-based solution the local machine is only a thin client that is used to present the data processed by the central web server and to collect data from the users. The central web server and database hold all logic and stores all data in a centralised manner. For such a solution to be functional, state of the art networks providing high speed connections and a very high degree of stability is needed.

As we have explained, such a demanding 100% web-based solution is the new vision of the Cuban government, and we question the mismatch between this demanding approach and the infrastructure found in Cuba. There are a few smaller areas in Cuba where the needed infrastructure for such an approach is in place, but large parts of the country suffer from poor and old telephone lines that make even modem connections difficult. In a flexible web-enabled solution, the amount of functionality to share can be adapted to the local infrastructures and adjusted to the local potential. Such a flexible approach with the visionary web-based solution only in a few places and a more suitable and less distributive solution in other less developed parts, we argue would be more suitable for Cuba.

The DHIS software was developed in 1997 and the GUI, the “look” of the software has not changed since then. The development idea was to focus on functionality and not on a fancy look. However, as it is now six years since the software was developed and many things have changed in software production, the GUI has started to look outdated and old. From a rational view, providing the needed functionality and being user-friendly is all that matters, but from a user’s point of view the looks matter. The first impression is not the functionality but the looks and design of the first page, and to improve the first impression, a more professional and up to date GUI would help. In addition, new technology offer more features in GUIs like browsing and the use of multiple windows, and there are more possibilities in making a better looking GUI with advanced graphics that the Access/VB solution do not provide. In Cuba, there is much focus on new technology and often the choice of modern technology is more important than the functionality when developing a new system. In such a context, which is found all over the world, the old-fashioned Access/VB GUI does not impress.

Today’s MS Access and VB based system with a back-end and front-end architecture (ref. 7.1.1) does not clearly separate the business logic of the system, as this logic is found in various places in long and messy VB code. A three-tier architecture which is the most used architecture for web-enabled systems have a middle tier that holds this business logic. The three tier architecture consists of a database tier (or data layer), a

middle tier (logic layer) and a client tier (presentation layer) (Eckerson 1995). The great advantages of the three-tier architectures compared two the traditional client-server architecture is the possibility to handle large multiple user environment (ibid.). In the case of the HISP network, a separated logic layer would make it much easier to share development tasks around the global network. In today's architecture it is difficult to get the overview of the logic as it not a separate part of the architecture, but integrated into a large sequential code. As the situation is now, the development team in South Africa is overloaded in providing support to an international network of users, as opposed to being relieved by a global sharing of development tasks. Open source systems like the DHIS facilitate a global network of local systems development teams, but the source code of the present DHIS is not facilitating a shared development.

MS Access does do support large databases and the queries tend be slow when the size of the databases get too big. Database applications like the free and open source applications PostgreSQL or mySQL support scalable databases.

A web-enabled solution based on a three-tier architecture can easily be platform independent and build on free and open source technology, as free database and web server applications. While at the same time providing a web-enabled and up to date solution it will be a much cheaper solution to implement since it can be made a 100% open source and Microsoft independent product.

Summary of the DHIS evaluation

Based on our experiences with the DHIS software in the Cuban project we have argued that the software main strengths are the support for fast and easy translation to any desired language and a strong support for prototyping development methods. These strengths are crucial in facilitating a flexible design strategy based on cultivation. However, here are some aspects that we argue could be improved to make it even more suitable for such an approach; more flexibility in databases structures and reporting frequencies, and better documentation. These improvements are quite easy to implement. However, in order to meet the growing political needs of providing a more networked solution, we suggest an important and comprehensive upgrade of the software to a scalable web-enabled solution. To succeed with developing an HIS in Cuba, such an upgrade is necessary.

9.3 Cuba compared to other countries in the HISP network

Here we address:

Research objective 3:

Compare systems development experiences from Cuba with case studies from other HISP nodes and explore appropriate approaches to systems development in developing countries in general

In this section we will compare our experiences in Cuba with similar experiences from other countries in the HISP-network (see section 3.3.2). We will focus on three central

aspects of the process in Cuba that have been important also in several of the other countries:

1) Approaches to systems development

Here we focus on

- Participation; strength and forms of involvement from health workers and managers and problems
- Scale and coverage of the design strategy; did the project aim at full, partly or limited coverage?
- Development of local knowledge about the development and use of the actual information system

2) Approaches to health systems reforms and HISs

The HISP approach aims at local empowerment and local decision making. To what extent are such approaches part of official strategies and practices?

3) Approaches to organisational change and political brokering

Political support during the first phase of the processes in Cuba and the lack of such support during the second phase have been the most important issues during the process in that country. Health information is a highly political issue in Cuba. Is political "brokering" and conflicts related to health information systems as important in the other HISP countries? Power structures are likely to change as the use of information change. While decentralisation is promoted in some countries, it may be less wanted in others. Top level support is often crucial to be allowed to do a project such as the HISP.

Short comparison on infrastructural and economical context

In the comparison we draw on case materials from South Africa, India, Mozambique and Malawi. Cuba is in many ways very particular in this context of developing countries; it is very poor, but education and health services are well developed and free. While in terms of technical infrastructure, Cuba is comparable with poor countries as Mozambique and Malawi, the educational and health infrastructures are well developed and in many ways better than in e.g. India and South Africa. For example: while in Cuba a team composed by at least a doctor and a nurse is responsible for serving a population of 5-800, in India one trained health worker is serving a population that is ten times bigger. In terms of distribution of poverty and wealth, India and South Africa are much more diverse than Cuba, where equal access to health, education and other resources are much more equally distributed.

1) Approaches to systems development

South Africa

The process in South Africa has been driven by extensive participation and cooperation at multiple levels involving all levels from health workers and end users to managers and politicians. However, the scale of the project and the volatile political situation following the fall of apartheid, caused a relatively informal multi-levelled participatory process based more on improvisation and input from activists and interested parties than from formal committees. The challenge has been to ensure access to the development team by all relevant and interested actors from various political and health sector levels. (Braa and Hedberg 2002). An important lesson from South Africa is to include multiple

levels and a variety of departments and health programs. The power relation between the actors and the possible conflicts related to this had to be carefully negotiated through the participatory process.

Obtaining coverage and scale were the key issues behind the success in South Africa. The full implementation of new minimum datasets, software and other procedures in two provinces in 1998 convinced the other provinces and the national level about the appropriateness of the approach and the national rollout started. Until then the project had only achieved partial "pilot" implementation which was less convincing, since the issue of "scaling up" is what is regarded as the main problem in Health Information Systems development. The large *scale* of the project ensured its success (Braa and Hedberg 2002, Braa, Monteiro and Sahay 2003).

In South Africa extensive human resources development in the HIS area is going on. The project started with cooperation between the University of Western Cape and a team of professional developers that are still present today. Since DHIS is used nationwide, there are many persons acquiring skills in maintaining and developing the system. A number of one-week courses covering various aspects of HIS development are run at the University and in the provinces. More than 3000 health workers have so far attended the courses (Braa, Monteiro and Sahay 2003).

Mozambique

The process in Mozambique has been of a smaller scale and only three pilot areas have been involved over a longer period of time. However, also here the participation has involved several levels and different health programmes and sectors. It has been important not to change the power relations between the leadership and the subordinate staff, while still getting valuable input and provide learning to the latter. The HISP project is based at the university in collaboration with the Ministry of Health, thus securing an institutional framework for long-term commitment (Kaasbøll and Nhampossa 2002).

The infrastructure in Mozambique is very poor and most districts do not have electricity and can thus not be equipped with computers. This has caused problems because it has been difficult to establish good strategies for obtaining scale and coverage. Without covering all health districts, it is hard to make a unified reporting system functioning both at health offices with and without computers, and this has been the main problem in Mozambique. Implementation in only a few districts is not seen as interesting neither from the provinces nor from the side of the Ministry of health (Braa et al 2001, Skobba 2003).

Mozambique lacks trained personnel, both medical staff and IT proficient people (Braa et al. 2001). Mozambique has through a joint masters program with universities in South Africa and Norway developed a "core" of DHIS-able people. Both medical and IT students have enrolled on PhD programs and are actively involved in the development and scaling up of the new HIS.

India

Larssæther (2003) and Meland (2003) write about training of health workers in India. Since caste and hierarchical social structures are prominent in India, two groups of participants had to be made to be able to include higher officers in the training, since they were not comfortable with being trained on equal terms with the lower status field workers, and vice versa. Participation in this centralised setting was possible however, contrary to in Cuba. Work groups with management and health workers could take place, but preferably separated in different groups.

The health districts are very big in India, typically 3-4 million people and the large amount of health units under each administrative unit makes it hard to achieve full coverage (Braa, Monteiro and Sahay 2003). There have been discussion on what level computers should be placed, but this is, as we will see for Cuba too, also a discussion on the sizes of datasets and to what extent the process promotes local management.

Both Master and PhD students contribute in India as well. A strong focus on IT in both the states where HISP is involved has secured a highly skilled work force of IS developers. Cooperation with actors in this sector has led to new developments and local modules communicating with the DHIS databases.

Malawi

In Malawi the process have been driven from the Ministry of health and the new system including new reporting procedures have been implemented. The organisational structure in Malawi is fairly simple with only 18 districts, which make full scale implementation relatively easy (Braa, Monteiro and Sahay 2003). This makes the system more sustainable, as a unified system with full coverage gives the health management useful information, and not just incomplete data useless for most practical reasons.

Cuba compared regarding participation

Compared to the other HISP nodes, the participation in Cuba has been very narrowly conducted inside the statistics department and the involvement of the local levels has been complicated due to a centralistic tradition. India has bureaucratic centralistic health systems comparable with Cuba, but local level participation as well as some inter-sectoral participation has been made possible due to high level support. In Cuba the strong centralistic and vertically organised structures stopped the participation with other departments. The failure to include several departments and sectors resulted in little technology learning, since most statisticians were pretty unfamiliar with computers, not to mention development. The involvement of the local levels have also been problematic in Cuba

The strict control on participation in Cuba has led to little *technology learning* (Braa, Monteiro and Reinert 1995). Crucial for sustainability is the learning about both *use* and *development* of the system (ref. 2.2.1), which can not be achieved solely with the training of statisticians.

Cuba compared regarding scaling up and coverage

Scale and coverage have been important in all countries including Cuba. DNE, in Havana, often expressed concerns about the limited usefulness of the system for the central level because it was not providing all the needed data. Despite of this, they refused to scale up the project in order to reach full coverage in the two provinces where we were working. This conflict was related to the unwillingness to give more autonomy to the local levels, which could have been the consequence if computing resources had been decentralised. Furthermore, if local autonomy in terms analysis and use of information was obtained, reports and information could easily be distributed horizontally to other departments within the health sector at municipal and provincial levels. This would have broken the DNE's information "monopoly" and thus indirectly reduced their influence and power at the central level, since the various departments would be able to get information reported through their own structures. The tense political situation in Cuba made it difficult for individual actors to take risks and try out new ways of organising the information flows. Even to try to achieve success in an alternative project as HISP was seen as being too risky. Only in this context is it possible to understand why DNE did not want to try to achieve full coverage of a decentralised HIS in the two provinces. The intention was to scale up with 60 more computers donated from Norway after 6 months, but this was stopped from the central level.

Cuba compared regarding local knowledge of use and development

The development of "long-term" national teams has been important in South Africa, Mozambique and India. Also in Cuba there were attempts to create such a national team with the overall responsibility for the project. However, this was not successful as there were not enough resources allocated and it was not prioritised by DNE. There are several small nodes of skilled groups, but due to lack of a national nucleus they are not communicating. A central support group should have linked all these local groups, as in Matanzas, Fomento and Yaguajay/Mayajigua. Given the little top support, these local initiatives are likely to dissolve quite rapidly.

To include the educational sector was also possible and the intention regarding Cuba, but as other attempts to include a broader range of actors, this did not happen. The universities should have been actively involved in HISP in Cuba as has been the case in the other countries. In this way the well developed university sector could have been utilised to the advantage to the development. At the same time this would have contributed to the development of capacity in systems development in Cuba.

2) Approaches to health systems reforms and HISs

South Africa

In South Africa the whole health system was to be changed, and it was strong political support for the primary Health Care approach, the decentralised district model and the need for local analysis and use of information was acknowledged. The ground was fertile for implementing a decentralised system aiming at local empowerment and equity in health, and the PHC approach was selected. Political support in principle was ensured.

Mozambique

The current information systems in Mozambique are of very poor quality and the government have been reluctant over many years to go for a decentralised approach. However, this is changing and there is now a strong drive towards decentralisation and it is decided to implement the HIS at the district level all over Mozambique over the next 3 years.

India

India also has a centralised health system, with many hierarchical levels. By involving and working through the central level, centralistic structures not necessarily hamper local empowerment. In India there is a central will to computerise local levels, and improve local use of information for decisions.

Malawi

Malawi has initiated the development and use of DHIS by itself. It was thus a political decision to computerise the district level, *and* to decentralise the health information system.

Cuba compared regarding approaches to health systems reforms and HISs

In Cuba the project has been a side project, opposing the existing power structures, meeting much more resistance than in other countries. An important aspect to remember is that Cuba, as opposed to the other countries when initiating the HISP projects, has a well functioning health and health *information* system that they are proud of, and that their intention with HISP was merely to improve the effectiveness of their current routines than changing the routines. A reform towards decentralisation of the health information system was not high on the agenda, and as discussed in section (ref. 9.1.2), the perspectives on information and information use are quite different from what is embedded in the HISP approach. The existing system is paper based, with computers and some applications at the two highest levels.

Like in India and Mozambique, and as we also experienced during the first phase in Cuba; top level support is crucial when trying to enhance local analysis and use of information. This support vanished with the old Minister of Health though, and with the new agenda our sphere of action was greatly decreased.

An important difference between the other HISP countries and Cuba is the political will to change the health information system. The acknowledged goal of the other HISP nodes is to improve local use of data. This shows how important it is with a softer approach in Cuba. While the other countries had a strong wish to improve their HISs, the Cuban interest seemed limited to explore the possibilities of applying new technology and modernise the existing system, strengthening the central control of the information. The Cubans had no immediate plans of initiating decentralised health reforms as was the case in the other countries. Therefore, limiting the conflicts between the HISP processes in Cuba and the present system is important in a revised approach discussed in section 9.1.3.

3) Approaches to organisational change and political brokering

South Africa

In South Africa the HISP was one of several projects competing for the political support of the Ministry of Health in the initial phase. The support in South Africa started from the bottom levels, where HISP had been actively developing both essential datasets and the software. Only when the system and data sets were implemented in two full provinces did the rest of the country acknowledge the approach and top level political support was gradually ensured. The political environment in the country after the fall of apartheid made local approaches without top support possible. Furthermore, the political constitution is relatively federal giving much independence to the individual provinces. Organisational change in the health system was at the top of the ANC's political agenda and was a prerequisite for the initiation of HISP.

Mozambique

The province is the focal unit in Mozambique, and a problem has been to get support at provincial levels to work in their respective districts. Changing the entire reporting and information system in Mozambique requires decisions at the governmental level. At the national level the HISP initiative has competed with several other projects over several years. This has made it impossible to scale up the project in order to reach full coverage and thus demonstrate the advantages of the approach. Without showing results, support has been difficult to obtain. This vicious circle is now finally broken and the Ministry of Health in has decided to implement the HISP approach countrywide over the next 3 years.

India

In India the HISP has received support from the Chief Minister's office in Andhra Pradesh, but not from the Ministry of Health. This conflict between the political and top health bureaucratic levels has been difficult to handle, but it made it possible to start in one area, the chief ministers electoral constituency(!). Based on achievements here, and continuous political support, it has been possible to convince the health department and to get support also from that side. This "overruling" of the health ministry by the state ministry has reduced the resistance to organisational change considerably.

Malawi

Malawi represents the "ideal" HISP node, in that the HISP effort in the country is self-initiated by the government. The organisational change by focusing on the districts was then implemented with top support.

Cuba compared regarding organisational change and political brokering

The organisational change in Cuba, following the HISP-approach to decentralisation, would have been tremendous. As discussed earlier (ref. 9.1.3), that was also a part of the reason for the strong resistance against the initiative.

Essential to the development process is participation, both horizontally and vertically. Even if this is hard in e.g. India, where some issues of caste and hierarchy had to be solved ad-hoc, it was not denied from the top level, whereas in Cuba the participation

was restricted from the top level. The fundamental issue regarding participation is whether it is allowed or accepted; yes or no. In Cuba the partly hidden answer to this question was no. We could freely interact within the statistics department, but the participation across departments was restricted and the local level participation was gradually stopped during the second phase of the project.

Cuba presents an example where political conditions have played a more negative role than other HISP countries. The political changes in South Africa were tremendous, and the HISP agenda about empowering the local levels was part of the political goals in the New South Africa. The political situation is different in the other countries and none of these countries have gone through such dramatic changes in such a short time. While most countries agree on the political movement and goals that turned over apartheid, they tend to be less eager to accept the implicit political and organisational changes in terms of decentralisation. However, most countries agree in principle to "decentralisation" and it is part of the global agenda also pushed by the UN, WHO, World Bank etc. Agreement to some extent about the principles, even in Cuba, could therefore form a point of departure when negotiating the direction for information systems design and development aiming at increased local involvement and empowerment.

Summary of comparison of all HISP nodes

The comparison of Cuba with the other HISP nodes reveals that there are some general lessons to draw from all cases. The three aspects of the processes of systems development are closely related to *sustainability*. In order to achieve sufficient learning and knowledge about systems development and use, high levels of cooperation and participation are needed. It is also important to reach a certain scale and coverage in order to make the system meaningful for both end-users and higher level managers and "politicians". Without political support, systems development in sensitive areas as health is not likely to become sustainable. Also, the relevance between the HISP influenced system and the current system is important. If the two systems are too different, leading to organisational change, and there is not enough political will to drive through the new one, this will lead to the abandonment of the new system.

9.4 Technology transfer in a critical perspective

Here we address:

Research objective 4:

Present and discuss different perspectives on the term technology transfer

Based on the discussions and analysis of our project done so far, we will discuss the term technology transfer. As mentioned in section 2.2.1, the term technology transfer is a bit problematic when explaining a transfer of information systems. The discussions on the process of "transferring" the South African HIS in the previous sections have pointed out that the process has been a complex development process heavily influenced by social aspects of the Cuban context. This includes the Cuban views on systems development, health information, and health information systems. Political brokering

has also played a major part in the process. The importance of technology has thus been overshadowed by contextual challenges, and we therefore find the term technology transfer inadequate.

9.4.1 Applying the technology transfer lifecycle model

In Figure 3 (section 2.2.1) we presented the Technology Transfer lifecycle proposed by Baark and Heeks (1998). The model views the technology transfer as 5 phases:

1st phase: Choice of technology
2nd phase: Purchase and installation
3rd phase: Assimilation and use
4th phase: Adaptation
5th phase: Diffusion/innovation

Baark and Heeks (1998) talk about technology transfer in general terms and more as a transfer of IT infrastructure and tools than information systems. Kaasbøll and Nhampossa (2002) are more specific and analyse a transfer of a public sector information system, the same South African HIS that we have "transferred" to Cuba, but their case is different in many ways. They adjust this model to better fit the more specific case of transferring a public sector information system. In their adjusted model, organisational change is added to the third phase. The degree of change varies with the amount of political support and the resistance of the present system and social structures. In Cuba this change did not occur due to the strong installed base and the far too radical change promoted by a decentralisation reform. Malawi on the other hand, is an example where a high degree of organisational change did occur as a result of decentralising computer resources and subsequently empowering the health districts by developing improved routines for local information use. The third and the fourth phase are considered to take place in parallel. Kaasbøll and Nhampossa do not mention the methodologies for adapting the HIS, most likely since these methodologies were well suitable to the context in Mozambique. In addition, the analysis put forward by Kaasbøll and Nhampossa gives a very simplified view of the adaptation phase. In our opinion, adapting the South African approaches to HISs is a complex task and involves a much more comprehensive development process than the one described in their analysis.

Using this framework to analyse our project, we will have to further modify the Technology Transfer lifecycle for it to better reflect what we experienced.

In our case, more than transferring an information system from South Africa that has to be adapted in Cuba, we can say that we developed a new system in Cuba with the help of a transferred database tool (DHIS) from South Africa. Moreover, this development process has been led by the Norwegian researchers in the role as foreign consultants, and this process has followed the same methodologies that were used in the South African HISP project, methodologies that are central in Scandinavian IS literature (ref. section 2.1.3). Thus, in our case, the adaptation phase can be understood as a systems development phase including database modelling, design, redesign and local adaptations. And the methodologies used to "adapt" the HIS to Cuba were also part of the transferred package that we have called the HISP-approach (ref. 3.3.1).

Furthermore, we can say that the database tool that was transferred has certain properties on information use inscribed, properties found in the South African HIS that are based on WHO guidelines for health information. These properties, if not present already, call for an assimilation process in the organisation where the information system is to be implemented. This assimilation can be seen as organisational change, and as Kaasbøll and Nhampossa (2002), we will expand the third phase in the technology transfer lifecycle to include organisational change.

The development of a Cuban HIS has gone in cycles between mutual learning, assimilation and adaptation. This cyclic process has been driven by the methodologies user participation, evolutionary prototyping and action research.

The development process was all the time influenced by political, organisational and economical actions (ref. 9.1.3), and in our model we will include a political influence aspect to illustrate how political decisions have directed the development in new directions.

All these influences are parts of what translates the technology. Even from the very start in Oslo, when the first delegates from Cuba were presented the software, they had a different interpretation of it; it was beginning to translate according to their perspectives.

Figure 43 shows our adjusted model of the technology transfer lifecycle (Baark and Heeks 1998).

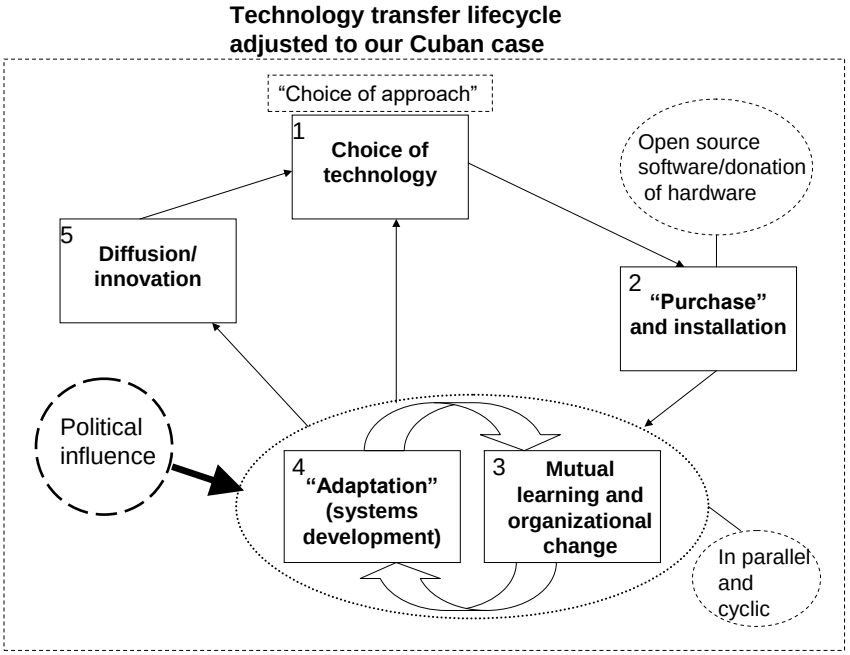

Figure 43. Tech. Transfer lifecycle (Baark and Heeks 1998) adjusted to the Cuban case

Phase by phase, short description of actions:

Phase 1 was the choice of the Cuban ministry of public health and we were not involved in that process. It was a choice to develop a HIS in Cuba based on the one found in South Africa, with a HISP-approach to HIS development.

Phase 2 included a Norwegian donation of computers and installation of this equipment together with the free and open source software tool that did not have to be purchased. The installation of hardware also consisted of adapting Norwegian equipment to the Cuban electrical standards.

Phase 3 and 4:
The main action in the project happened here. With the help of the software tool we developed a prototype, redesigned and made local adaptations. A continuous training process at all levels and a mutual learning process between users and developers, led to new and improved redesigns and database solutions and technological learning among the local participants. These actions were cyclic and followed an evolutionary prototyping method with new designs and constant improvements to the prototype. These processes, at least in the first part of the project, were driven by methodologies like action research, user participation, a bottom-up approach, and with a local focus. The development process was influenced by political decisions and we experienced huge changes in strategy during the project (ref. section 6.2.3 and 7.4.3). As we have discussed, there was little will to organisational change in order to assimilate to the inscribed properties found in the software (ref. 9.1). These properties represented a much bigger challenge in our Cuban case than in the similar Mozambican case that Kaasbøll and Nhampossa (2002) have analysed.

Phase 5 has not been initiated as the project still is in a pilot phase.

9.4.2 Development of a new system rather than "transfer"

Our task has been to transfer a health information system from South Africa to Cuba. As we have seen from the literature review, among other theories, the Web models (Kling and Scacchi 1982) argue that an information system can be understood as a social system that encompasses social aspects like human behaviour, routines, and politics in the context where the IS is implemented.

Figure 44 shows important elements of the South African HIS from this social systems perspective. To "transfer" these elements does not make sense, they have to be developed and cultivated locally. When explaining a transfer of information systems, in this case a health information system, we find that the process is more of a *re*-development process than transfer. We can say that our task was to develop a Cuban HIS in a Cuban context, following certain philosophies both regarding health information systems and IS development from South Africa. We have defined this approach as the HISP-approach, which has to be adjusted to the Cuban context. Figure 45 illustrates this development process.

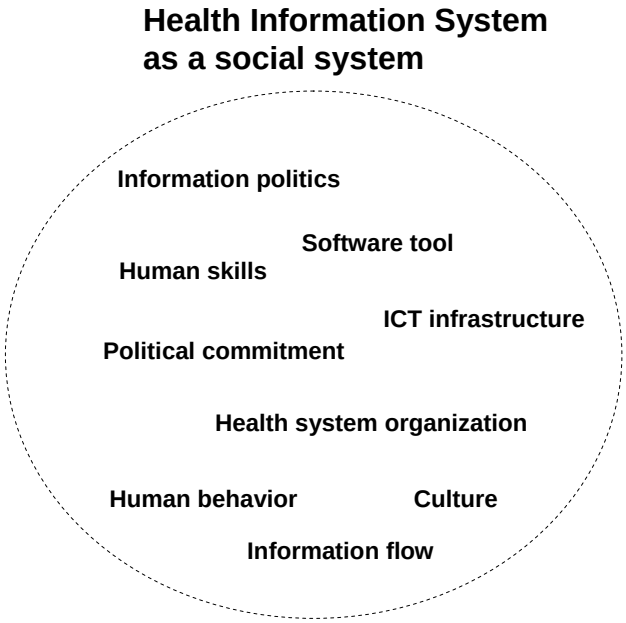

Figure 44. The South African HIS as a social system

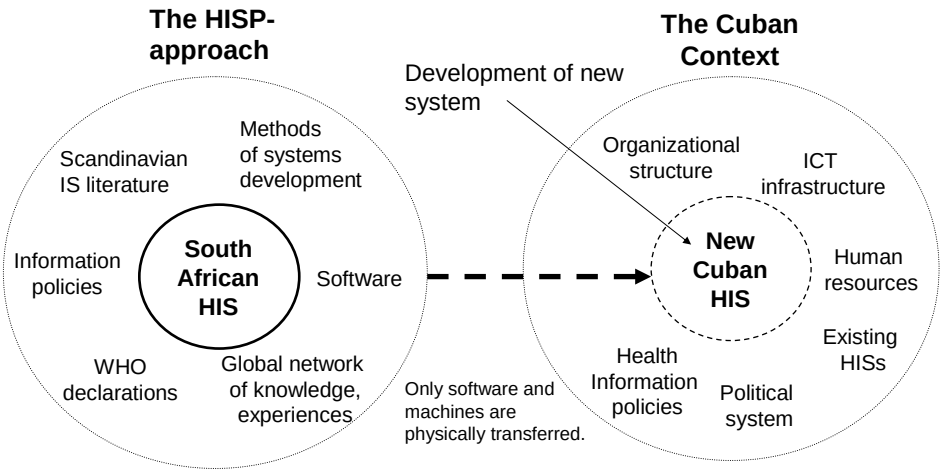

Figure 45. Development, rather than transfer of a HIS in Cuba based on HISP-approach

But *redevelopment* is not a proper term either, since the goal is not a replication of the system previously developed. Only the tools and methods from South Africa were brought to Cuba, together with some hardware, and these tools and methods have to be locally adapted too, like the system being developed. We have seen that process of developing a system is influenced by the way the methods work, how the local

approaches to health information reforms and HISs are compared to what promoted by the HISP, the structurational change required, and political brokering.

Development requires learning of use and development

For the development to be sustainable, it requires that also local knowledge about development and use of the system is being developed. Among the many obstacles to sustainability in Cuba was the lack of adequate technological learning. It was difficult to get a team together that could participate in the development of the new system. The development process was only driven by the Norwegian participators, and thus the development stopped as soon as we left. The nature of the project, with evolutionary prototyping and local adaptation to each case, requires both local knowledge *and* local knowledge about system development. The Cuban case thus supports the notion of *technological learning* (Braa, Monteiro and Reinert 1995), that an important part of a technology "transfer" is to ensure that the technology is learnt and mastered. This learning of use and development should also include the development of *local development methods*, methods specifically suitable to the local context (Korpela et al 2000). These methods are not "invented" yet, since each country or context is special, but have to be developed together with the local stakeholders, which again requires local participation in the development process. Traditionally Cuban systems development has focused on a top-down implementation of pre-made systems. A method sensitive to both this approach to the Cuban power structures *and* the necessity to involve local end-users in the process should have been developed

Development understood as successive translations

Drawing from Akrich's (1992, 1993) work (ref. 2.2.1) another way to look at the process of diffusing or transferring technology is *translation*. The notions of technology transfer and technology learning assume a diffusion, were technology originate at one place, and from there diffuse to other places, unchanged. The translation, derived from actor network theory, fits better to our experience. When the technology is moved to a new context, its content, goal and meaning are being changed according to the new actor-networks including the new technology that are being formed. This can be seen as successive processes of translation, where translation is represented by processes where the technology and the actors in the new context gradually align their interests, adapt to and influence each other, and thereby cultivate and inscribe their interests into the new technological systems.

In our case, the DHIS, regarded as an empty database, was very much the same, but the way it was used, or not used, was a translation or adaptation of the technology. The software and the ideas of health information and development methods were taken from the South African context and installed into the Cuban. The old actor network of which the software was part and had been developed within was replaced with new actor networks, instantly transforming the technology. New actor-networks were created in Cuba as a whole and in the various pilot sites where the system was put into use. In the different places where the system was introduced relatively distinctively different kind of networks were formed resulting in different translations. For example in Sancti Spíritus where the provincial team aimed at networking the different sites and where the computer responsible travelled around to each site together with the authors trying to align the activities. In Fomento the Polyclinic and the local health units became the

key focus and another organisational structure was used in the database and in data collection and analysis. In Matanzas the information responsible collected the essential dataset for all the Municipios in order to strengthen the provincial level.

The larger HISP- actor-network in Cuba was made up of all the sites and sub-networks as well as the various central actors and political agendas. These various actors of the overall Cuba network followed different and conflicting agendas during the course of the project. While in the first phase all actors agreed on a set of goals for the project this changed drastically in the next phase of the project. The overall political agenda in Cuba changed, basically because of the global political and security situation, and we have discussed how these changes in the political climate influenced directly the work in the project. The Cuban actor-network that was relatively well aligned in terms of goals and interests in the beginning was disrupted in that the DNE started to pursue other goals and interests and eventually closed down most activities. Global

Drawing on Akrich's (1993) study from Sweden and Nicaragua, we can identify some processes of translation that took place when the technology was moved from South Africa to Cuba. Three different database structures where implemented in the different sites and in DNE centrally. They all represented different goals and ways of using the technology. In the Polyclinics, Municipalities and Provinces the database technology, its use, the way it was perceived and the way it became part of and aligned within the actor networks may all be understood as distinct translations. In terms of content and use of the information systems, these different translations represented varieties of the original focus on local use and analysis. At the central DNE level yet another distinct translation was represented by the hospital (MH) database and the wider network of which this database was a part.

The actors of these various "sub actor networks" were made up of software, data standards, users, ….

These "sub" actor- networks represent different levels of the health system, and together they make up the larger "HISP-network" in Cuba. Two issues related to ANT as an analytical tool are important here; 1) the variety of translations together with the high level of conflict discussed indicate that the networks were poorly aligned, and 2) the scalable use of ANT where the wider network contains sub-networks, and when scaling up further we see that even global events and the general political situation on Cuba become important actors. This latter issue of scalability of ANT is similar to Monteiro (xxxx), …….

This database is a direct mapping of the existing Cuban HIS into the DHIS, translating the software from a primarily local tool to a tool used for central DNE level. The DHIS is here translated to a reporting tool for central control and surveillance. Such processes, greater or lesser in importance, *translate* the technology from South Africa to the Cuban context. The influence goes not in just one direction; the technology influences the actor networks too, for example by providing local offices with computers and facilitating more local use of data.

Figure 46 illustrates how the technology is taken from South Africa and put in new actor networks. Together with ideas on development and information use from South Africa, the Cuban actor networks and context *translate* the technology to its new

environment. In the initial phase of the project a wide variety of translations occurred as adaptations to the needs of the different levels of the health system.

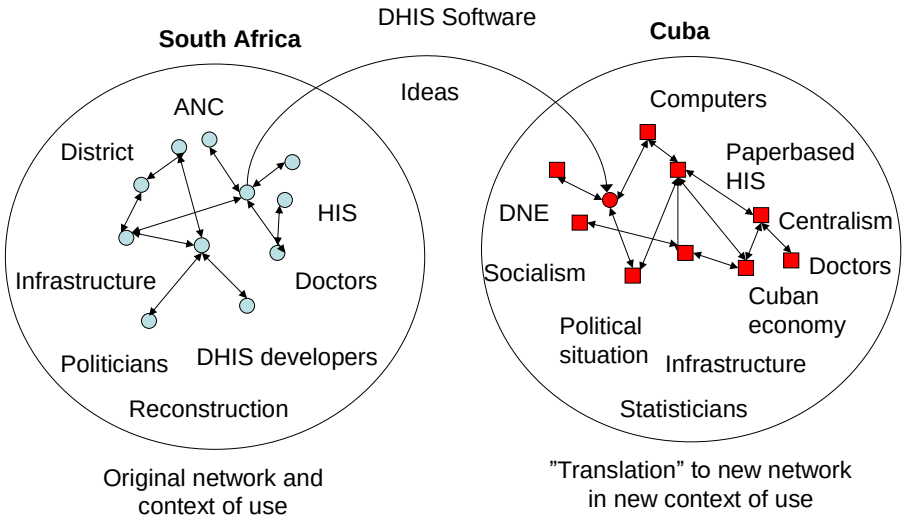

Figure 46. The translation of DHIS by new actor networks

Summary

We have seen how the term technology transfer was inadequate to explain the process of transferring the HISP-approaches to HISs development from South Africa to Cuba. Based on the social systems perspective on ISs we argued that the transfer from South Africa to Cuba is better viewed as a local development approach that is influenced by transferred methods and ideas on how to develop the HIS.

Applying the perspective to see technology transfer as a process of technology learning has provided a better understanding of the Cuban development processes. This view is based on the argument that technology cannot just be transferred is must also be learnt. Local knowledge both to use and to develop information systems is crucial in order to develop sustainable systems.

Finally we reviewed the perspective of understanding technology transfer as successive processes of translation. In this perspective the technology and the local context is adapted to each other in translation processes, and we applied this concept on the South African-Cuban transfer to understand how the Cuban HIS is a translated and adapted version of the South African.

9.5 Summary of the discussion

We have discussed the appropriateness of applying the HISP-approaches in Cuba, and argued that the approaches need to be adapted in order to be appropriate in the centralised context. The participatory approach and local involvement in systems development have been impeded by the fragmented, centralised and authoritarian structures of the Cuban health system.

We have suggested a more appropriate approach to systems development and HISs in Cuba, which we argue must emphasise central political support to obtain sustainability. This can be achieved through a cultivation strategy that focuses on covering the information needs and infrastructure of the existing system. In such an approach the new system is developed upon the old to assure a piecemeal process of organisational change that is sensitive to the political context in Cuba.

The software tool has been an important asset in supporting a turbulent participatory prototyping approach, and made it possible to implement the changing requirements quickly. The multilingual feature that facilitated fast translation to a Spanish version of the user interface was crucial to the development. However, in order to meet the growing political needs of providing a more networked solution, we suggest an important and comprehensive upgrade of the software tool to a scalable web-enabled solution. To succeed with developing an HIS in Cuba, and developing countries in general, such an upgrade is important.

The comparisons with other developing countries in the HISP network show that an approach aiming at sustainability is crucial for systems development in developing countries. An important part of this is learning of use and development, securing sufficient local knowledge through participation and collaboration. A cultivation of the existing system, focusing on covering the information needs of the users, is an appropriate approach to develop a useful system and to obtain a slow incremental change process that is likely to meet less political resistance.

We argue that technology transfer is inadequate to describe the process of transferring information systems. The notion of technology learning better capture the fact that local knowledge both to use and to develop information systems is crucial in order to develop sustainable systems. Another notion explains the transfer not as diffusion, but translation. The technology and the local context is adapted to each other in translation processes, and we applied this concept on the South African-Cuban transfer to understand how the Cuban HIS is a translated and adapted version of the South African.

10 Conclusion

In this chapter we will summarise our research and make some concluding remarks on the most important aspects of developing health information systems in relation to our research objectives.

Research objective 1

Study the context for systems development in Cuba more generally and within the health sector more specifically

The development process has been influenced by the Cuban context in many ways; Cuban politics, power relations within the health system, traditions on information handling, technological infrastructures, global politics, human resources and human behaviour. Politically, Cuba has proven a more difficult context for HIS development than any other HISP node. Cuba has suffered from a rapid marginalisation after the fall of the Soviet Union and in many ways reflects a developing country considering infrastructure, computer resources and networks. However, the well structured Cuban health system and health information systems together with an incredible amount of educated health staff do not reflect a typical marginalised developing country. Considering the resources within the health sector, Cuba has a huge potential in achieving sustainable computerised health information systems. Given the strong contextual influence on our HIS development we argue that ISs have to be looked upon from the perspective of understanding them as social systems.

Research objective 2:

Discuss and explore appropriate approaches to systems development and HISs in a Cuban context

Participatory design as an approach to systems development addresses the need for adaptability demanded by the social systems perspective. A participative design method was possible and to some extent appropriate as a way to develop a locally adapted IS, even in the hierarchical context of the Cuban health system.

Furthermore, **prototyping** has been crucial in facilitating participatory approaches in Cuba. The flexible prototyping tool DHIS made it possible to adapt to the rapidly changing demands and provided the flexibility needed for a participatory process.

However, we have encountered some problems with the participatory prototyping approach, and especially the focus on the local involvement and participation was problematic to the top level decision-makers in Cuba. Therefore we argue that not only the IS, but also the development methods themselves need to be adapted to the local context. Thus, in order to sustain, the development methods need to be adapted to the Cuban context, and first of all be sensitive to the political situation and the needs of the decision-makers.

We have suggested a strategy taking the existing infrastructure and installed base as a point of departure when developing a truly adapted health information system. The new system must be developed upon the existing, cover the information needs and provide scalability in order to be considered an appropriate replacement. We propose a **cultivation** strategy to meet these context sensitive needs. Cultivation is a gradual approach that allows for improvisation and flexibility which is necessary in order to adapt to and build on the installed base.

Research objective 3:

Compare systems development experiences from Cuba with case studies from other HISP nodes and explore appropriate approaches to systems development in developing countries in general

The lessons from other HISP nodes and our Cuban case strongly suggest that systems development needs to be sensitive to the existing installed base, where coverage and immediate usefulness is pivotal in order to cater for the existing information needs and thereby to get political support. Political support and the issue of coverage have been key elements in all the HISP-countries. This strategy of building the existing HIS strongly supports an approach based on cultivation. In developing sustainable systems in developing countries, local **learning** about development and use of the information systems is crucial. A cultivation process based on participation and cooperation, focusing on learning, will thus be appropriate.

Research objective 4:

Present and discuss different perspectives on the term technology transfer

Learning to develop and to use ISs is crucial to any so called "technology transfer" project in developing countries. Technology transfer can be seen as successive processes of **translation**, where translation is represented by processes where the technology and the actors in the new context gradually align their interests, adapt to and influence each other, and thereby cultivate and inscribe their interests into the new technological systems. While translation represents an analytical level of understanding the processes of adaptation, **cultivation** may be regarded as an appropriate strategy to facilitate, nourish and direct such translation processes. Learning based approaches such as cooperation and **participation** represent concrete development approaches that facilitate the cultivation strategy. We have seen from our case in Cuba as well as from the other cases that participation and cooperation need to target and include multiple levels of the health bureaucracy. The "traditional" end-user focus of participatory design approaches is therefore not sufficient.

We turn to our own research and, despite the difficulties experienced, conclude that our **action research** approach created a lot of knowledge we could not have achieved in any other way. Only through close collaboration and action with local stakeholders, pursuing a solution to a real problem, could we acquire the local knowledge and insights necessary to understand the problem area. While we sometimes were restricted in movement and collaboration, these lessons contributed to the research and would not have been detectable from "the laboratory". As a method for learning, action research facilitated a fertile mutual learning process. However, the political development in Cuba

made up important obstacles in achieving true participation and mutual learning in our action research project, and its sustainability was severely hampered.

The HISP network has produced a range of action research case studies, from South Africa, Mozambique and India, which have been valuable to our research and understanding of the theory and logic behind information systems development in developing countries. This Cuban study has provided many interesting findings, and through comparison with other studies we have been able to generalise some ideas and thus contribute to the field of IS and developing countries.

Our project started much more promising than it eventually ended up, with local focus *and* top level support in the spring of 2002. The events of the summer that year had direct consequences on the project that we had no ability to understand before returning to Cuba for the second phase of the project. It turns out that many global factors have influenced the course of the project. It started when the terrorist attacks in New York sparked the Bush government to increase pressure on the "axis of evil", to which Cuba was counted. Political attacks from the U.S., and later also the EU, was used as excuses to arrest dissidents. Foreign collaboration projects were not as prioritised as earlier, and the new Health Minister had no intention to continue the old projects from the previous minister. As the director of DNE later told us, the project and our stay in Cuba, was "bad timing".

There are now computers in some polyclinics and municipal offices in Cuba where the DHIS is installed, and training has been given in entering, analysing and using data. Some seeds are sown at local level, and with the available skilled human resources and analytical tools of the software there is a chance that a piecemeal process cultivating local use of information is silently going on.

11 List of acronyms

AR	Action Research
ATM	Automatic Teller Machines
CEDISAP	*Centro Para el Desarollo de Salud Pública*, The Centre for the Development of the Public Health
CMEA	Council for Mutual Economic Assistance
CMF	Consultorio Médico de Familia, Family Doctor Office
DHIS	District Health Information System
DNE	*Dirección Nacional de Estadísticas*, The National Office of Statistics within the ministry of health
ETECSA	*Empresa Telecomunicaciones de Cuba, SA*, Cuban Telecommunication Provider
EULA	End User Licence Agreement
GBT	*Grupo Basico de Trabajo*, Working group of family doctors
GUI	Graphical User Interface
HDR	Human Development Report
HCIS	Health Care Information System
HIS	Health Information System
HISP	Health Information System Programme
ICT	Information and Communication Technology
MH	*Movimiento Hospitalario*, Hospital Patient Flow
MINSAP	*Ministerio de Salud Pública*, Ministry of Public Health
MINVEC	*Ministerio para la Inversión Extranjera y la Colaboración Economica*, Ministry of foreign relations and economic collaborations
NORAD	Norwegian Agency for Development Cooperation
OECD	Organisation for Economic Co-operation and Development
PHC	Primary Health Care
RHINO	Routine Health Information Network

List of acronyms

SIEC	*Sistema de Información Estadística Complementario*, Complementary statistical information system
STI	Sexually Transmitted Infections
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
UPS	Uninterruptible Power Supply
WHO	World Health Organization
WITFOR	World Information Technology Forum

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Appendix A: The Consultas Externas subsystem

Instructions for the forms seen in Figure 47 and Figure 48 below:

Modelo 241-416-01
CONSULTAS EXTERNAS

OBJETIVO (Objectives)
Conocer las Consultas Externas que se realizan en el país para evaluar los Programas de atención.
(Obtain information on the consultations in the country to support the evaluation of medical attendance programs.)

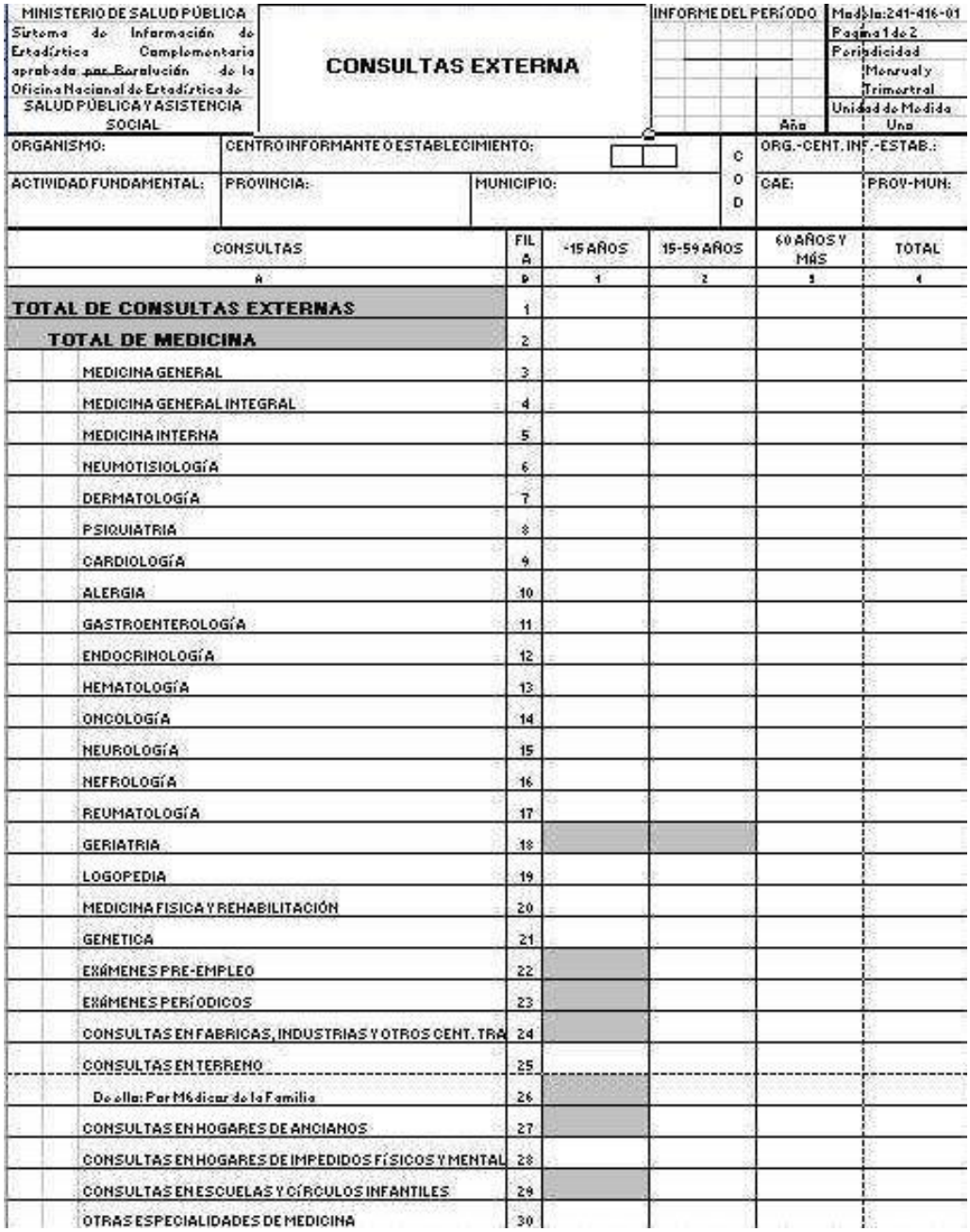
FLUJO DEL MODELO (The flow of the form)
Original: *Dirección Nacional de Estadísticas,* ***1ra. Copia:*** *Dirección Provincial de Salud,* ***2da. Copia:*** *Dirección Municipal de Salud,* ***3ra. Copia:*** *Centro Informante.*
(Original: National Office of Statistics, 1st copy: Provincial health office, 2nd copy: Municipal health office, 3rd copy: Informing Unit)

CARACTERIZACIÓN DE LOS CENTRO INFORMANTES (informing units)
Es informado por todos los hospitales, policlínicos y otros centros que realicen consultas en el País.
(Informing units include hospitals, polyclinics and other units that give consultations in the country)

INSTRUCCIONES DE LLENADO Y REVISION
(Large section with instructions on how to fill out the form not included here.)

REVISION LOGICA Y ARITMETICA (Logic revision and calculations)
TOTAL DE CONSULTAS EXTERNAS (referring to a subsection in the form)
La fila 1 columna 1 será igual a la suma de las filas 2 ,31 ,43, 55 en la columna 1 respectivamente más la fila 56 columna 5.
La fila 1 columna 2 será igual a la suma de las filas 2, 31, 43 y 55 en esa misma columna.
La fila 1 columna 3 será igual a la suma de las filas 2, 31, 43 y 55 en esa misma columna.
La fila 1 columna 4 será igual a la suma de las filas 2, 31, 43 y 55 en esa misma columna.
En la fila 1 la suma de las columnas 1 a la 3 será igual a la columna 4.
Short translation: Row 1 column 1 equals the sums of the first column of rows 2, 31, 43 and 55. The same relationship exists for columns 2, 3 and 4 for the same set of rows. And in each row the sum of columns 1, 2 and 3 equals column 4.

Table 12. Instructions for the *Consultas Externas* subsystem



MINISTERIO DE SALUD PÚBLICA
Sistema de Información de Estadística Complementaria aprobado por Resolución de la Oficina Nacional de Estadística de SALUD PÚBLICA Y ASISTENCIA SOCIAL

CONSULTAS EXTERNA

INFORME DEL PERÍODO — Año

Modelo:241-416-01
Página 1 de 2
Periodicidad: Mensual y Trimestral
Unidad de Medida: Uno

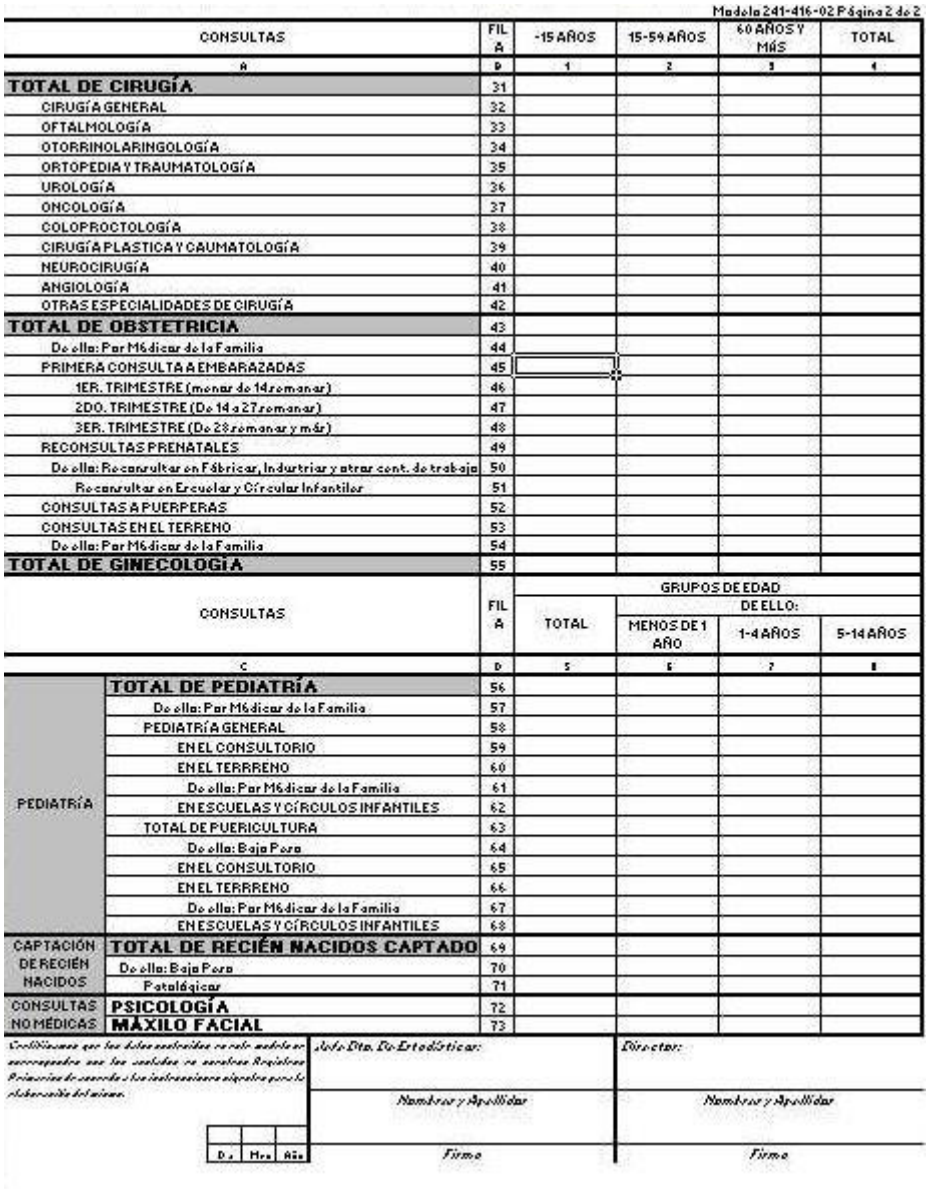
ORGANISMO: | CENTRO INFORMANTE O ESTABLECIMIENTO: | COD | ORG.-CENT. INF.-ESTAB.:

ACTIVIDAD FUNDAMENTAL: | PROVINCIA: | MUNICIPIO: | CAE: | PROV-MUN:

CONSULTAS	FILA	-15 AÑOS	15-59 AÑOS	60 AÑOS Y MÁS	TOTAL
A	B	1	2	3	4
TOTAL DE CONSULTAS EXTERNAS	1				
TOTAL DE MEDICINA	2				
MEDICINA GENERAL	3				
MEDICINA GENERAL INTEGRAL	4				
MEDICINA INTERNA	5				
NEUMOTISIOLOGÍA	6				
DERMATOLOGÍA	7				
PSIQUIATRIA	8				
CARDIOLOGÍA	9				
ALERGIA	10				
GASTROENTEROLOGÍA	11				
ENDOCRINOLOGÍA	12				
HEMATOLOGÍA	13				
ONCOLOGÍA	14				
NEUROLOGÍA	15				
NEFROLOGÍA	16				
REUMATOLOGÍA	17				
GERIATRIA	18				
LOGOPEDIA	19				
MEDICINA FISICA Y REHABILITACIÓN	20				
GENETICA	21				
EXÁMENES PRE-EMPLEO	22				
EXÁMENES PERÍODICOS	23				
CONSULTAS EN FABRICAS, INDUSTRIAS Y OTROS CENT. TRA	24				
CONSULTAS EN TERRENO	25				
De ella: Por Médicos de la Familia	26				
CONSULTAS EN HOGARES DE ANCIANOS	27				
CONSULTAS EN HOGARES DE IMPEDIDOS FÍSICOS Y MENTAL	28				
CONSULTAS EN ESCUELAS Y CÍRCULOS INFANTILES	29				
OTRAS ESPECIALIDADES DE MEDICINA	30				

Figure 47. Page 1 of the Consultas Externas subsystem.

Explanation: Note that this form holds 112 data entries to fill in. Each of the types of consultations are registered for three age groups (<15, 15-59, >60) and a total. The blue fields indicate that this is no to bet filled out. The left column uses tabulated spaces to indicate totals and subtotals, and which types of consultations that are grouped together."TotalConsultas Externas" is the overall total for the form, and "Total de Medicina" is a subtotal which holds all medical consultations. The types of consultations below this subtotal are subgroups of that subtotal.



Modelo 241-416-02 Página 2 de 2

CONSULTAS	FILA	-15 AÑOS	15-59 AÑOS	60 AÑOS Y MÁS	TOTAL
A	B	1	2	3	4
TOTAL DE CIRUGÍA	31				
CIRUGÍA GENERAL	32				
OFTALMOLOGÍA	33				
OTORRINOLARINGOLOGÍA	34				
ORTOPEDIA Y TRAUMATOLOGÍA	35				
UROLOGÍA	36				
ONCOLOGÍA	37				
COLOPROCTOLOGÍA	38				
CIRUGÍA PLASTICA Y CAUMATOLOGÍA	39				
NEUROCIRUGÍA	40				
ANGIOLOGÍA	41				
OTRAS ESPECIALIDADES DE CIRUGÍA	42				
TOTAL DE OBSTETRICIA	43				
De ella: Por Médicar de la Familia	44				
PRIMERA CONSULTA A EMBARAZADAS	45				
1ER. TRIMESTRE (menor de 14 semanar)	46				
2DO. TRIMESTRE (De 14 a 27 semanar)	47				
3ER. TRIMESTRE (De 28 semanar y más)	48				
RECONSULTAS PRENATALES	49				
De ella: Reconsultar en Fábricar, Industriar y otrar cent. de trab-aja	50				
Reconsultar en Escuelar y Círcular Infantilar	51				
CONSULTAS A PUERPERAS	52				
CONSULTAS EN EL TERRENO	53				
De ella: Por Médicar de la Familia	54				
TOTAL DE GINECOLOGÍA	55				

CONSULTAS		FILA	GRUPOS DE EDAD			
			TOTAL	DE ELLO:		
				MENOS DE 1 AÑO	1-4 AÑOS	5-14 AÑOS
C		D	5	6	7	8
PEDIATRÍA	**TOTAL DE PEDIATRÍA**	56				
	De ella: Por Médicar de la Familia	57				
	PEDIATRÍA GENERAL	58				
	EN EL CONSULTORIO	59				
	EN EL TERRRENO	60				
	De ella: Por Médicar de la Familia	61				
	EN ESCUELAS Y CÍRCULOS INFANTILES	62				
	TOTAL DE PUERICULTURA	63				
	De ella: Baja Para	64				
	EN EL CONSULTORIO	65				
	EN EL TERRRENO	66				
	De ella: Por Médicar de la Familia	67				
	EN ESCUELAS Y CÍRCULOS INFANTILES	68				
CAPTACIÓN DE RECIÉN NACIDOS	**TOTAL DE RECIÉN NACIDOS CAPTADO**	69				
	De ella: Baja Para	70				
	Patológicar	71				
CONSULTAS NO MÉDICAS	**PSICOLOGÍA**	72				
	MÁXILO FACIAL	73				

Certificamos que los datos anotados en este modelo se corresponden con los existentes en nuestros Registros Primarios de consulta y de conformidad con las instrucciones vigentes para la elaboración del mismo.

Jefe Dto. De Estadísticar:

Nombrar y Apellidar

Firma

Director:

Nombrar y Apellidar

Firma

D.r	Mes	Año

Figure 48. Page 2 of the Consultas Externas subsystem

Explanation :Note that this form holds another 162 data entries to fill in, making the total number of data entries for Consultas Externas form 278. The blue fields in the first column indicate subtotals and the rows below are subgroups to that subtotal. The age groups for paediatrics "pediatria" is different form the other subgroups, with <1, 1-4 and 5-14 years.

Appendix B: Database Modelling

Design of the data sets

Essential minimum dataset

The pilot database system was targeted at capturing monthly routine health data and we selected four of the most important subsystems from the Cuban HIS that contain this type of health data. All four subsystems have the same reporting frequency and aggregation level. From the units and up to the municipal level there is monthly reporting, and to the provincial and national level, there is quarterly reporting. The municipal offices calculate municipal aggregates that they report to the province, and the provinces report the provincial aggregates to the national level.

The four subsystems selected were the following:

1. Consultas Externas

This is an extensive list of patient load per medical specialty with an age break-up of 15, 15-59, and 60 + (–1, 1-4, 5-15 for pediatrics). Since this two-side sheet is on a tabular form, it adds up to 278 elements. The form can be seen in Figure 47 and Figure 48 in Appendix A.

2. Vacunación + Programa de Vigilancia Nutricional + Programa Tuberculosis

Data related to immunization, nutritional surveillance and Tuberculosis. One sheet used on both sides. Totally 69 elements.

3. Gíneco – Obstetricia

All data related to deliveries. Totally 71 elements.

4. Declaración Obligatoria

A list of communicable diseases. Totally 3591 elements. Actually 3591 is the maximum of elements that can be reported for one month. The form has 21 categories based on age and sex that make up the columns. The rows are blank and a disease code is filled in for each case. The number of elements reported is dependent on the number of cases for the last month. 3591 represents the reported elements in the hypothetical case where there are cases for all diseases for all groups of age + sex.

These four subsystems make up a collection of 4009 data elements to report. As explained, the form of communicable diseases give a hypothetical maximum of reported elements, while the average number is more likely to be 0-100 dependent of the actual communicable disease cases in that unit. Note if the database system demands a 0 for every element that has no cases, there will be 3591 elements to report every month. These zeros however, can be generated automatically, and represent no workload for the

data entry clerks. In a paper-based system, in this form, only the cases are reported, so the zeros are not considered here.

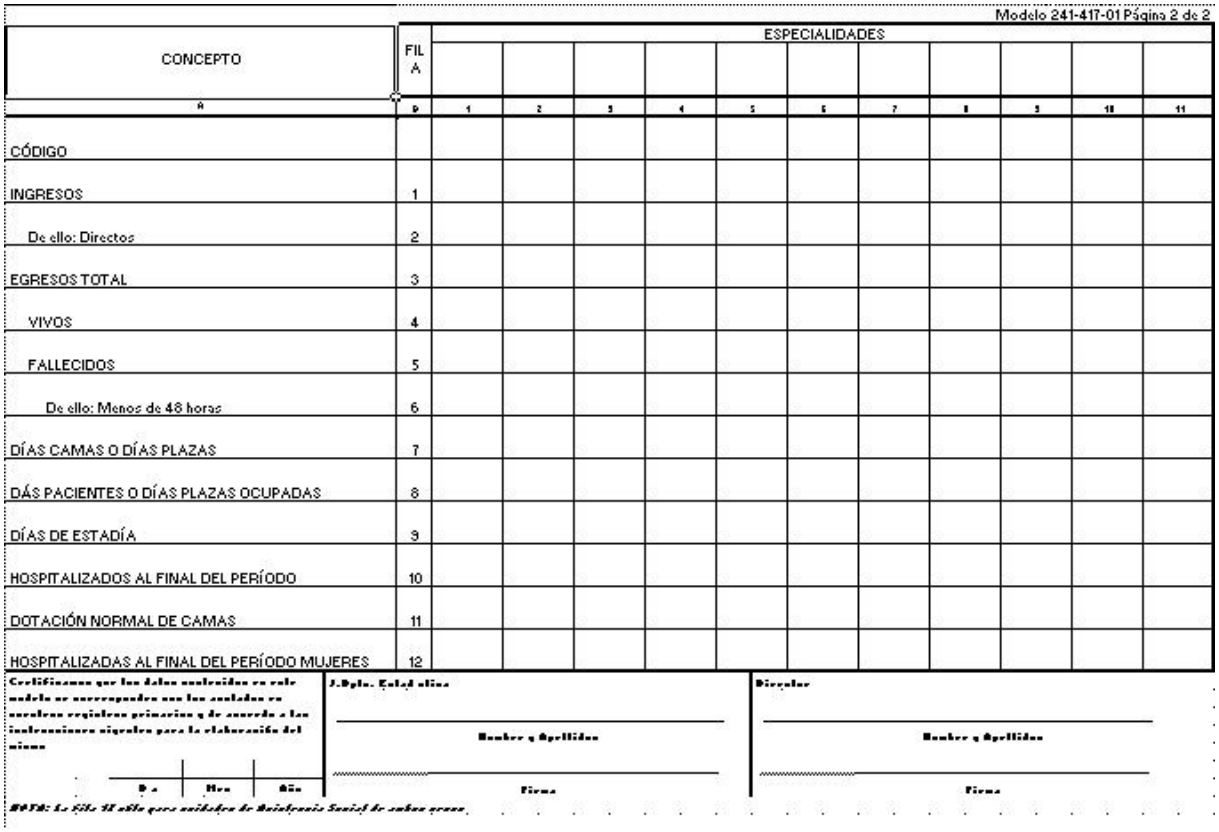
All these forms are more or less used at every health unit and they cover the most important aspects of routine health data, so they suited our goal to get an overall analysis. Together they make up 4009 (about 500 reported on paper) data elements, and considering our strategy to capture data as low as the working group and health unit level, 500 data elements would be too much to handle for a paper-based reporting system up to the level where the computers are, as well as too much data to enter into the computers at the municipal or provincial offices.

To be able to maintain good quality data with a large 'maximum' dataset there is a need for higher aggregation levels and a higher level of data capture. To provide information-support at the local level the aggregation level must be low. A lower aggregation level demands a smaller dataset to provide quality data, and it is impossible to provide quality data when having both a low aggregation level and a large number of data elements. To provide both good quality, low-level data and an extensive enough dataset for the national level, we had to make an essential dataset with the most important data elements from the selected forms. The four selected subsystems totally contained about 500 (see the comment to the communicable diseases' form above) data elements and we needed a selection of less than 50. With this in mind, the Cuban project responsible and the Norwegian project coordinator identified an essential minimum dataset of 36 elements selecting the most important elements from the four subprograms, plus a few new elements. As an essential maximum dataset for possible use at a later stage, they selected all data elements from these subprograms.

This essential minimum dataset was a national dataset that all reporting units within the scope of the project had to report. This way we could develop a national database based on this national dataset with working group-data and health-unit data from all the pilot municipalities in the two provinces. The working group structure below facilitate this reporting structure.

Maximum hospital dataset and other maximum datasets

Starting with the new maximum dataset approach, we found out that the subsystem for hospital patient flow could be a good pilot database. The hospital hierarchy is quite small compared to the PHC considering both levels and units involved. Another interesting issue considering the hospital system is that the data is captured per unit and not aggregated at a later stage. The DNE uses hospital data at unit-level when analyzing this subprogram at the national level. As we have explained earlier, in most subsystems data is aggregated to municipal and provincial totals. This means that a new hospital database system, with proper use at the provincial level, can provide useful local data for hospital management at each hospital. A technical issue favouring a hospital database pilot, is that the subsystem for hospital patient flow data is a straight forward form that can easily be modelled into a hospital dataset. As seen in Figure 49 the form, called *Movimiento Hospitalario* consists of 12 data elements (*concepto*) that is cycled for every ward (especialidades) at the reporting hospital.



Modelo 241-417-01 Página 2 de 2

CONCEPTO	FILA	ESPECIALIDADES										
A	B	1	2	3	4	5	6	7	8	9	10	11
CÓDIGO												
INGRESOS	1											
De ello: Directos	2											
EGRESOS TOTAL	3											
VIVOS	4											
FALLECIDOS	5											
De ello: Menos de 48 horas	6											
DÍAS CAMAS O DÍAS PLAZAS	7											
DÁS PACIENTES O DÍAS PLAZAS OCUPADAS	8											
DÍAS DE ESTADÍA	9											
HOSPITALIZADOS AL FINAL DEL PERÍODO	10											
DOTACIÓN NORMAL DE CAMAS	11											
HOSPITALIZADAS AL FINAL DEL PERÍODO MUJERES	12											

Certificamos que los datos contenidos en este modelo se corresponden con los anotados en nuestros registros primarios y de acuerdo a las instrucciones vigentes para la elaboración del mismo

Día Mes Año

Jefe Dpto. Estadística

Nombre y Apellidos

Firma

Director

Nombre y Apellidos

Firma

NOTA: La fila 12 sólo para unidades de Maternidad Social de cubos grave

Figure 49. Reporting form of the hospital patient flow subsystem, Mov. Hospitalario

The *Movimiento Hospitalario* (MH) subsystem was already computerised in an old FoxPro database that is used at the national and provincial level. All hospitals in Cuba use the MH subsystem and report to their authorities, either the municipal, provincial or national health statistics office. This reporting is paper-based up to the provincial level and there it is entered into the FoxPro database. From provincial to national level they use electronically reporting by e-mail. Another reasons for selecting the MH subsystem as a first pilot in this new development strategy was the possibility to export old data from the FoxPro database to the new hospital database.

In December 2002, we started to design a hospital database and modelled a hospital dataset including all data elements from the paper-based counterpart. At that time there were plans to develop other similar databases based on maximum datasets, subsystems like *Gíneco- Obstetricia* (child-mother data) and *Vacunación* (immunization) were possible choices. Both these subsystems use aggregated data at higher levels, and it will be difficult to implement database solutions with a low-level data capture for local use. Using the maximum dataset approach the new databases are almost exact computerizations of the paper-based subsystems, and can more easily replace the existing systems. An essential dataset approach, despite its many advantages was too different from the existing system to be considered a realistic replacement of the existing system, at least for the next few years. Maybe in a longer perspective, when local management is stronger in the Cuban health system, an approach with an essential minimum datasets with action-led data can succeed.

Design of the database structures

In section 7.1.2 we mentioned some characteristics of the database tool that puts some constraints on the process of modelling database structures; here is a recap of those constraints:

Constraints on software regarding database structures:
- The software tool facilitates the modelling of the database structures and there are some rules that have to be followed:
- There can be up to 5 levels in the database hierarchy
- Reporting units can only be situated at the lowest level in the hierarchy

Important decisions on database structures:
- How can we map the Cuban health system into a database structure?
- How to use the available computer resources?
- How can we tailor solutions to all levels?

Depending on the information flow and the units involved in the information system that we are designing, we select the levels and units that are needed to make up the database structure. If we want to design a hospital database, the structure would be all hospitals plus all administrative levels that administer hospitals. If we want to capture data at the family doctor office-level, all levels from national to family doctor office should be included in the structure to map the correct information flow. If the working group is the capturing-level, family doctor office, since it is below the working group in the hierarchy, will not be included in the database structure. This illustrates how the data-capturing level/aggregation-level decides how useful the data is locally. A family doctor has no interest in data that are captured at the working group level.

The working group structure

This structure was developed in June 2002 at the national office in Havana. The task was to model a structure to fit the demands of a national database to be used in the two pilot provinces. The data to capture is defined in the essential minimum dataset, and the data-capturing level was decided to be the working group-level for PHC-data and the health units-level for the remaining data.

Given the working group as the lowest data-capturing level, all administrative levels and units down to the working group had to be part of the structure. As we have seen, the software permits up to five levels, and data capturing only at the lowest level. Let us recap the levels and units:

Administrative levels:
National
Provincial
Municipal
Health Area (only PHC data)

Data Capturing Units
National units
Provincial units
Municipal units
Working groups (only for PHC data)

The first three levels where straightforward with the national, provincial and municipal levels, all administrative levels. The fourth level was a bit tricky. Considering PHC data, the municipality is divided into one or more health areas, which is a geographical area. Each area has one polyclinic that serves the population within the area. The polyclinic again is divided into one or more working groups, the level we want to capture. About 80% of all the data captured in the area comes from the different working groups, and the last 20% are specialist data captured at the polyclinic itself. In order to enter these specialist data we needed the polyclinic at level 5, the same level as its logical children, the working groups, not an ideal mapping of the reality of the health system, but necessary. This way, the health area at level 4 will have 100% of the data from the area combining level 5 data from its working groups and the unit with PC-specific data. Using this approach, it is important to make sure that the users separate between working group-specific and polyclinic-specific data, so that the sum of both of these data add up correctly to the total for the health area. These data are separated at the polyclinics since there is a statistician dedicated to the specialist data and others dedicated the working group data.

Another design issue was where to put the individual health units that report non-PHC data directly to their authorities, the municipal, provincial or the national office. Following software restrictions, they have to be at the lowest level to admit data-capture, and we placed them under the health area where they geographically belong.

It is important to notice that these solutions that are not perfectly modelling the reality of the structures are only affecting how the data can be entered. When analyzing the data, these fixed solutions will not be noticed. As an example, national hospitals can easily be excluded from health area or municipal totals in analysis even if they are entered under that area.

This structure as seen below in Figure 23 in section 7.4.1, has been used in six municipal offices, two provincial offices and a hospital.

Adjusting the Working group structure

After discussions with the DNE in December 2002, we decided to allow data capturing at the health area level, which means that it is possible to enter the total of the area, the sum of all the working groups and the PC-specific data directly into the database. Some municipal offices had complained that it was extra work for them to get data on the working group level, one level below what they use in the existing paper-based system. However, since many municipalities where positive to have the possibility to analyse data at the working group level, we found a way to accept both variants within the same structure, giving each municipality the flexibility to choose to capture data at the working group or health area. At higher levels in the hierarchy, this flexibility will not be seen or make any difference, since the municipal and provincial totals will be the same. As seen in Figure 50, we implemented this change adding an element at level 5

called ASentrada (*Area Salud* (AS) means health area, *entrada* means entry), under the health area level in the municipalities where they wanted to enter health area aggregates. Instead of entering data for every working group and the PC-specific data, they can just enter the total for the area in the ASentrada unit. We will make no changes where they want to continue entering at the working group-level. The sums at level 4, the health area-level, are then the same either way.

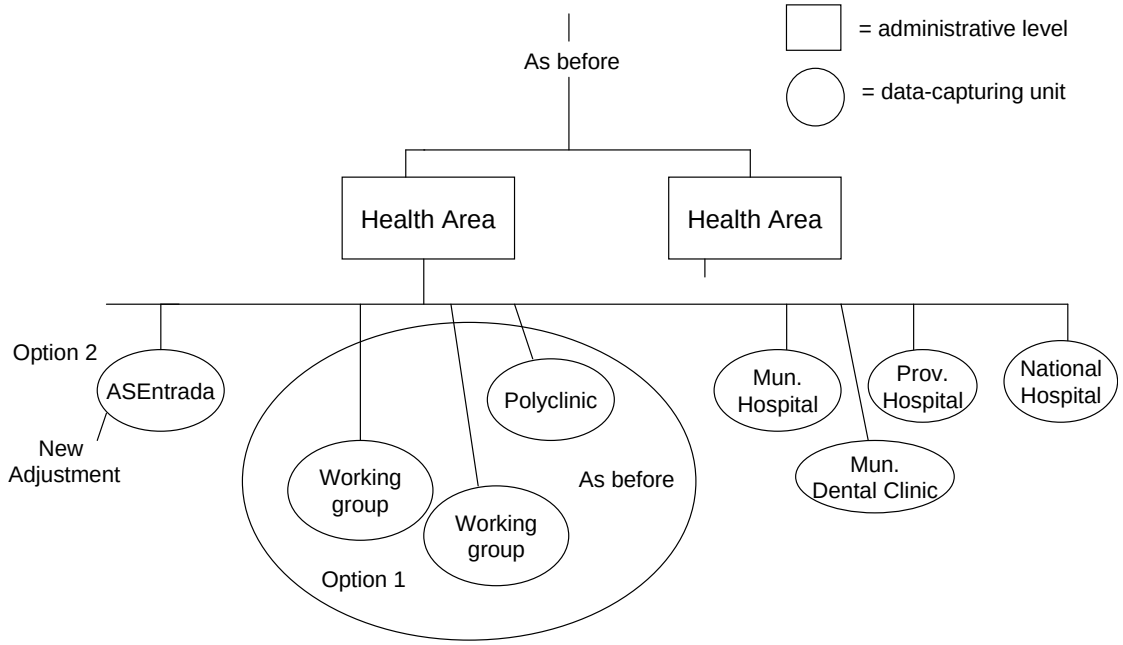


Figure 50. Working group structure with new adjustment

Explanation: Notice the flexibility to capture PHC data either as in Option 1 at working group-level or as Option2 at health area-level.
ASEntrada = health area entry, Prov. = provincial,
Mun. = municpal

The Polyclinic structure

This was designed to support data capturing at the family doctor level. An absolute demand was to make it compatible with the working group structure so theta the polyclinics using the polyclinic could easily report to the municipal offices using the working group structure. Such a compatibility solution must work so smoothly that the users do not notice that there is more than one structure.

Administrative levels:
National
Provincial
Municipal

Health Area
Working Group

Data capturing units:
Family doctor office
Polyclinic-specific data
These make up a total of six levels, thus one more than the permitted number of levels. Since this structure would never be used at the national office, we did not include the national level in the structure.

We made a structure with family doctor office at level 5, the working group at level 4 and the health area at level 3, municipal offices at level 2, and provincial offices at level 1 as seen in *Figure 51*. The unit called PCAdm is a dummy unit used only to store polyclinic-specific data apart from the working groups at level 4. Again, this small fix in the structure can easily be hidden when analyzing data.

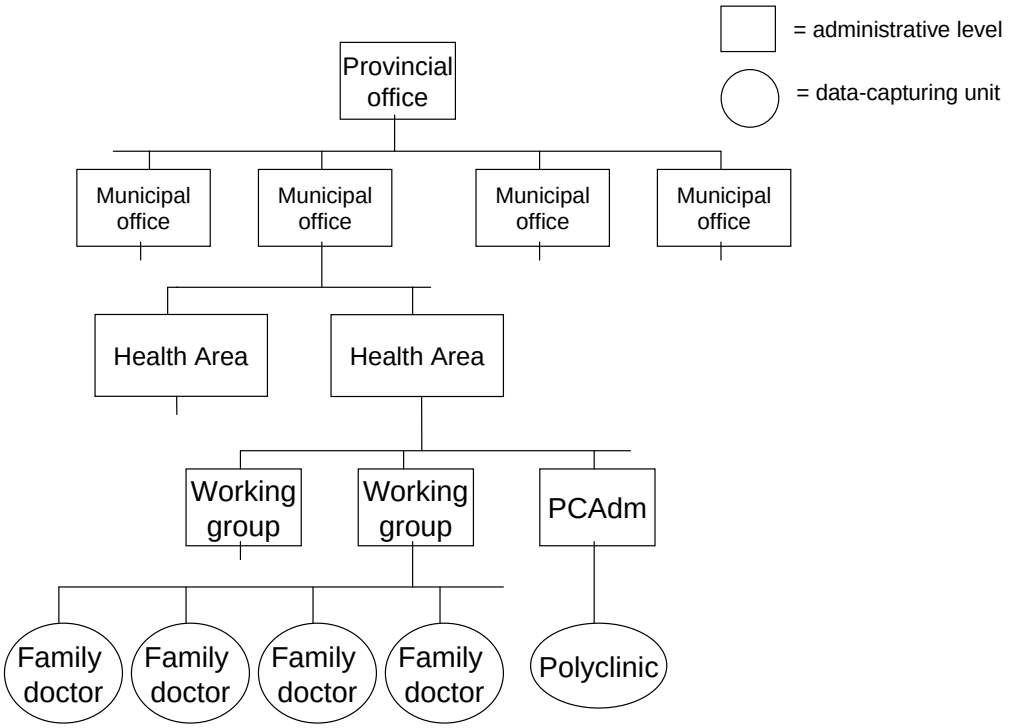


Figure 51. The polyclinic structure

Explanation: PCAdm = dummy level to store polyclinic-specific data

Compatibility issues

The import/export function in the software accepts only import at level five in the database structure. Therefore, to make the municipality able import the data as normal, we needed to make a small program to convert family doctor office data from level 5 in the PC structure to working group data at level 5 in the working group structure. The polyclinic-specific data is captured in a similar way in the two structures so these data

were easily translated to the working group structure. The export file used in the software is an ASCII text file, and we programmed a small Java program that reads the ASCII file with family doctor office data from the PC structure, calculates the data, and writes out a new ASCII file with working group-data ready to be imported into a working group structure.

The Provincial structure

This database structure was needed to support municipal aggregates that were reported on paper in the Matanzas province. The only levels needed are the national, provincial and the municipal. Since the software admits only fixed five-level structures, and we had only three levels in this structure, we created two dummy levels above the national level. This technical workaround have no affect on the system use.

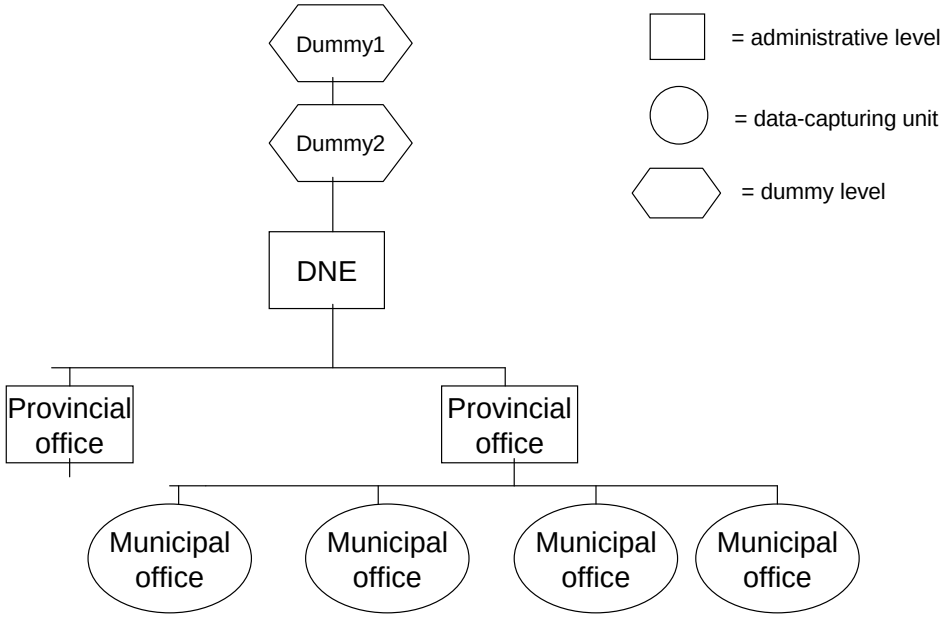


Figure 52. Provincial structure

Hospital structure

This structure was to be used with the maximum hospital dataset in the hospital database following the new maximum dataset approach after November 2002.

The subsystem to be mapped into a DHIS database is called *Movimiento Hospitalario* and is reported by every hospital in Cuba, and in this subsystem data captured by unit, and not further aggregated on the way up to the DNE.

The reporting form as seen in Figure 49 above has 12 data elements (rows) cycled for every ward (columns) in the hospital. The number of wards varies with the size of the hospital, and can be anything from 3-4 to the maximum of 41.

Discussion on structure –use wards or not?

Since there are hospitals subordinated from municipal, provincial and national levels, all administrative levels down to municipal, as well as all hospitals in the Cuban health system, have to be part of the MH structure. Furthermore, we discussed whether to use wards as a level below the hospitals, this to enter data for each ward in a hospital, since data in the existing paper-based system is reported by ward.

We had two alternatives on how to represent the wards in the database, either as a structural unit, or as data elements with prefixes that specifies which ward the data element belongs to. As an example, the number of patients that enter the paediatrics ward in the Havana Hospital can be represented in two ways in the database. One alternative is as a data element called *in_patients* that belongs to a level 5 unit called paediatrics that has the Havana hospital as its parent on level 4. In alternative two, it is represented as a data element called *ped_in_patients* that belongs to a level 5-unit called the Havana hospital, with *ped* as a prefix for the paediatrics ward.

Experiences from the other countries that use the same software, South Africa and Mozambique, show that both alternatives work fine, and we had to find out what would be most natural for the Cuban context.

In December when we started to design this structure at the DNE, the national staff was extremely busy with other more prioritised work, so we struggled to get any participation from them. With minimal participation from DNE staff in the discussion, we went for an approach using wards as prefixes to the data elements and hospitals as level 5-units. We did so because we thought this approach would mean easier data-entry for the statisticians, with fewer units to worry about. We did not finish the work on the MH structure before leaving Cuba, and the next master student to work in the project, Pål de Vibe, finished the work with the MH database.

In February 2003, de Vibe got more participation from DNE, especially from the project responsible, who now argued for the other alternative putting the wards at level 5 in the structure. Pål redesigned the structure to meet these new wishes, and ended up with hospitals at level 4, wards at level 5 and no prefixes to the data elements.

Pål de Vibe also found a way to better map the reality relationships between hospitals and their respective authorities. In the working group structure, we had put e.g. a provincial hospital under the health area where it geographically resides, instead of directly under its correct authority, the provincial office. We did so because the software only admits data-entry at level 5, but de Vibe found a way to put the provincial hospital at level 5 without attaching it to the health area or the municipal level. He designed dummy parents at the levels up to the right authority at the provincial level.

The Figure 53 below shows the MH structure designed by Pål de Vibe, showing ward as level 5, and the fix to link the provincial hospital directly to its right parent:

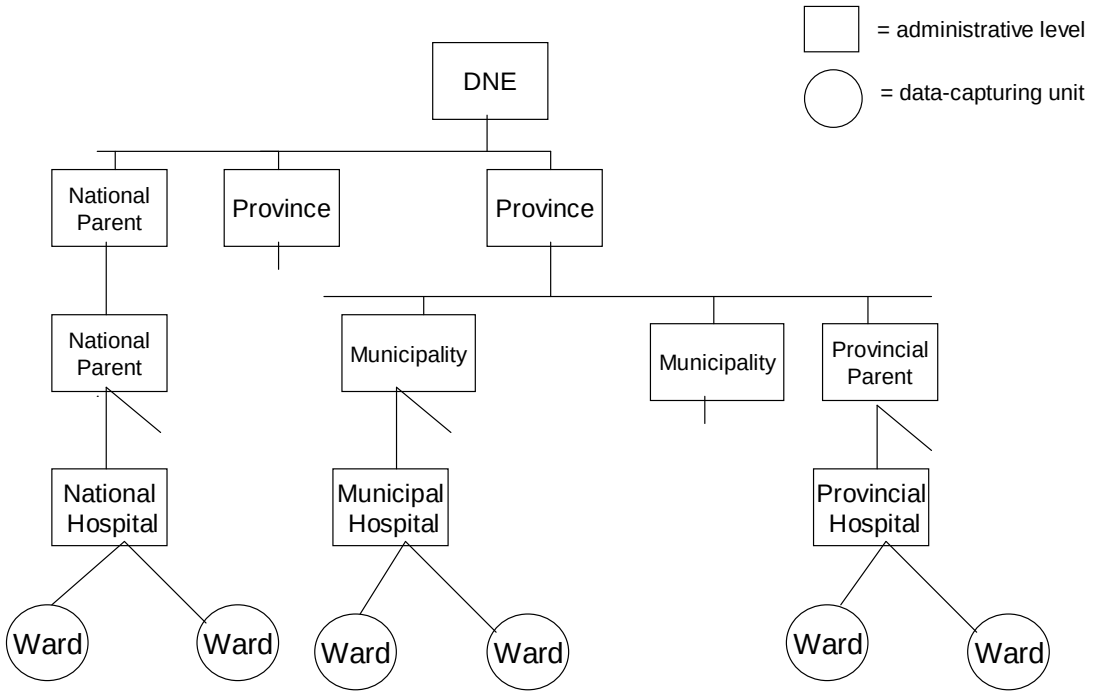


Figure 53. Hospital structure with wards and authority workaround

Appendix C: Case Studies

Here we present all the 13 pilot sites, with specially focus on participation. A short general description of each site is given together with the participation with the three groups; Statisticians, IT staff and Health Management.

Jagüéy Grande is described as one site, as is Fomento. The work at these places, even if at several offices, was so close, and we often gathered the statisticians from all places to work together.

Some places we spent more time due to prioritization or infrastructure and problems, and some cases provided more knowledge relevant for the research than others. It is thus natural that some cases are described in more detail than others.

DNE Havana

General info

DNE is located in the same building as the ministry of health in Havana. It is the top office for the health statistics, and the end node for all information systems within the ministry of health. DNE provides health authorities and political leaders with the latest health information, and the director has to provide exact numbers in regular meetings with the Health Minister, and even Fidel Castro himself. A publication of all important health data is made annually.

There are a total of 15-20 employees in DNE, most of them statisticians. There are also some employed as administrative and IT-technical staff. The staff is highly trained and well educated in their field. This is the office we spent the most time, both for setting up the project, define the databases, train statisticians at national level, and later when working on the collected material and implementing *Movimiento Hospitalario* in the software. The last Norwegian student spent almost all his time here. DNE has computers for all statisticians and the administration, and connection via a proxy server to the internet. Without the password to the proxy server, the local medical net, Infomed, can still be accessed. The computers are of various ages, some state of the art, but all good enough to run DHIS. The Cuban health information system is now stored electronically for just a short period of time, typically the last year on excel sheets, and the last quarter on a local developed database which can hold just one period at a time. Previous years are stored in books and on paper in a storing room.

Participation with statisticians

Several rounds of training were done at DNE. First, the main responsible for the project received some training to see the opportunities and limitations of the software. The first essential dataset were developed in collaboration here. Later more statisticians have been trained, a one week workshop was held in September 2002 by request of DNE. This workshop was highly amputated though, due to the resistance that had developed during the previous months. With no Cuban data yet, the resistance was further

intensified since South African data had to be used, on a language unspoken by most of the participants. Lack of time and organised rallies to support the revolution and their heroes also took its toll, and the workshop resulted in little. Later however, with Cuban data shown as pivot tables and graphs, there was some enthusiasm about the possibilities. When working with the MH at the end of our stay, we worked in a group with two to three Cubans, actively participating and implementing the system into the software.

Participation with IT staff

The participation with IT professionals at this level was disappointing. DNE had two employees just maintaining the computers there, and one of them was actively a part of the development team at the very end of our stay and together with the next Norwegian student. He was with us for a week in Sanctí Spíritus province, and was part of the DNE project team. However, at this level we expected some cooperation with CEDISAP, the system development center of the ministry of health. We had a couple of short meetings with them, but were unable to agree on joint cooperation and development. They were afraid it would be too time- and money consuming.

Participation with health management

Participation with the health management was also scarce. We had good communication with the management of DNE, but nothing with other departments. This became more apparent after the "revolution" in MINSAP during the summer of 2002. The director of DNE had to regulate the project, and keep it a small project inside his department due to the political environment at that time. While central interest in the project was what we needed, the lack of the same could close it down immediately. DNE decided to keep the project small, not to disturb other departments, and wait until things cooled off. A demonstration of the possibilities of the system for other users, e.g. central health managers and planners, CEDISAP, and other strategic departments was highly desirable for us, but was not considered appropriate at that time by DNE. The project was just in its infancy, had no big results (from Cuba) to show yet, and was fiddling with the national pride, the health services. At this level there was no interaction with other departments, only inside the statistics department.

Sanctí Spíritus provincial office

General info

The provincial office of Sanctí Spíritus is located in the city of the same name, no more than one and a half hour from the other pilot sites in the province. It is not far from the main east-west highway in Cuba, approximately 5 hours from Havana.

The staff of the statistics office consists of 7-8 persons, where all have some experience in use of computers. One has the role as an IT manager, and they also get some assistance from a person working with the computers in other sectors in the city. The IT manager has experience to the point of some programming. The IT manager travelled around with us and observed and participated in some training and discussions. Four machines were used in the statistics office, and they had two more next door for the

strategy group, an interesting factor in the project. The computers were of varying quality, but none very new and with the capability of performing the tasks DHIS needs at this level. The software used was mainly Microsoft Excel and Cuban-developed health software. This software is the same in the national office and the other provincial office, and is a DOS-based system from 1995-96. The office is using e-mail, on the telephone line, also with the aid of Cuban-developed software.

Participation with statisticians

The conditions for participating with the statisticians at this office were good. They felt responsibility for the project, and sent their IT manager with us to the different pilot sites in the province. While they were all busy working most of the time, it was easy to ask for their contribution regarding the database structures, data elements, and so on. The plan was that they would collect data from all municipalities during summer, to have a base to do analysis training with. This collection was ordered stopped by DNE. A general problem of this was that we never had any Cuban data to use in analysis training. The data sets we had were small, so sometimes we had to do training with South African data. The statisticians knew how to enter data, but were not allowed.

Participation with IT staff

The cooperation with the IT manager was good. He was on several trips with us to the various municipalities covered in the province. Our work together was mainly teaching local staff how to enter and store data, but there were also some discussions about technical issues.

Participation with health management

We had a meeting with the provincial director of health, which was promising. There are understanding and will to further expand and develop the databases, but central decisions prevent such from happening.

We tried to arrange a meeting in Sanctí Spíritus with statisticians and management from several municipalities and offices, but as mentioned earlier we were unable to do so. We were later confronted with this at DNE, and told we had no jurisdiction to arrange such meetings, even if the provincial office of statistics thought so and tried to arrange it. We have been told that they have been fired after we went back to Norway.

Sancti Spíritus Municipal Office

General info

The municipal office in the city of Sancti Spíritus caters the health administration of the 80 000 inhabitants of the city. It is a pretty large municipality, with 2-3 employees in the statistics department. As often the case in Cuba, there were problems here with electricity and making the modem work. The planned meetings at this office were cancelled a couple of times due to power cuts. The statistics office is located on a heavy trafficked corner in the old colonial part of town, making the diesel trucks pass half a meter from the open floor-to-roof doors used to let in “fresh” air. While making the work conditions generally poor, the dust from the streets could be a possible hazard for

the machine. While the Norwegian researchers were not present during summer 2002, someone had installed an older version of MS windows, together with some computer games. The DHIS then had been deleted.

Participation with statisticians

The statisticians at this office were very eager to participate in the development of the essential data set. Some training has been given in easy analysis too, with promising results. One of the statisticians has been appointed responsible for the computer, and given extensive training in entering and using data. Several thousands entries was entered during some intensive weeks between two visits. The chief statistician proposed data elements from other forms to include in the essential data set, especially elements for dental clinics, which had none before.

Participation with IT staff

There was no IT staff present at the municipal office, but given the proximity to the provincial office the IT staff we had contact with there could easily drop by for assistance. And the computer responsible of the statisticians was a fast learner and already had basic computer skills.

Participation with health management

The person responsible for the computer and the entering in the database in Sanctí Spíritus presented local data herself to the director, who was impressed by the easiness and power of the analytic tools. Except for the presentation, there were some discussions and talks which were promising. The fact that one of the statisticians were designated as a computer responsible and that the researchers were welcomed and given the right to intervene in the daily work of the statisticians is an important factor that the project was seen as important, even in the management itself did not have much time to spare.

Fomento Municipal Office and Polyclinic

General info

Fomento is a medium sized town 1 hour from Sancti Spíritus. The municipality office is one block from the town polyclinic, so all training etc was done with participants from both offices together. This was also a necessity, since the computer at the municipal office broke down quite early. In none of the offices did we get the modem to work.
There is a person very skilled in computers working at the municipal office. She learned the software quickly and also could teach the others there. The other personnel had never used a computer before, but were skilled in statistics. The statistics office at the polyclinic has 5-6 employees, none of which had any experience from computers beforehand

Installation and initial training was done in June. Also, in the end of the first phase, the new structure for polyclinics was installed, as the first place in Cuba. Little were done during summer, so we started almost from scratch on the second round of visits. More training and adding of more elements took place. To encourage them to use DHIS more,

results in the form of pivot tables and graphs were shown with Matanzas data. Also, a vice director was present, and he was impressed.

Participation with statisticians

The statisticians were eager to learn about the computer and the software, and we did quite some training here. As many of the other places, lack of basic computer skills is a huge problem. We used most of our time teaching how to start the software, and navigate around the different pages. This also cause them to not see the fully potential of the system, thus reducing the enthusiasm.

We found here what the statisticians called “datos negros”, black data. This is reports customised by local management, using a collection of data elements from the different health programs. Such report making is not encouraged by the DNE, who do not think local staffs have the knowledge to know what data is good or bad.

Participation with IT staff

One person at the municipal office was educated as computer engineer. She had good knowledge of Microsoft applications, and learned to use of DHIS very fast. Unfortunately, she was not always in town. A local expert group was created to maintain the computer, the software, and learn more about the DHIS. A young man with computer knowledge serving civil service at the municipality, the computer engineer, and one statistician formed the group. But the project was stopped in the provinces soon after, and the group has most likely dissolved without any backing from other pilot sites or higher levels.

Participation with health management

The authorities in the municipality were interested in the project from the start. After some short meetings however, we worked solely in the section of statistics. The vice director was shown data from the Matanzas database. Some more discussions with the management was desirable, but this could not be done due to lack of time from both parts.

Trinidad Municipal Office

General info

Trinidad is a city located on the south coast of the province. It is special in two ways. First, the surrounding terrain is mountainous, with special health programs for mountain villages. Second, the city is a popular tourist destination, with far more developed infrastructure than other similar-sized town in Cuba.
It is living 71 000 people in the municipality., divided on two polyclinics with a total of 142 family doctors. It has one hospital, and a rural hospital for the mountain area Topes de Collantes. A rural hospital is a polyclinic with some more services. Also there are dentists, maternity homes and a tourist hospital.
The telephone lines are digital, enabling use of the digital modem we brought from Norway. Also, with all the hotels with internet and the internet cafes in the town, it is

easy to get support. The telephone company ETECSA has an office just one block from the municipal office.

A problem that we were not aware of, and did not experience ourselves, is that during heavy rains the humidity will reach such levels that it can damage the machines. As Trinidad is not the only place without air-condition this could be a problem elsewhere too, but it was here that we were told that, after some heavy rains, computers at the local internet café had had some trouble with their computers. As in many of the offices the room is not protected in any way against humidity as it seldom has anything more than a big, open door that is vital to keep open for some fresh air.

Computer and printer were installed in june, and two days were spent there for initial training and discussions. No data were entered during summer, but the computer and modem were used daily to other purposes, such as sending electronic mail and writing documents. On our second visit we did some more training, discussed the experiences they had with the computer and modem, how to make the right data element set, and presented the results we had from Matanzas province.

Participation with statisticians

There are 2-3 statisticians working there, and we also had the help of a doctor working with the UN project which have installed a computer at a local polyclinic. He had some computer experience, and was of great help. There were one woman who had the responsibility for DHIS, and she took a great effort to learn the system and enter data. They are also very positive towards the system, and were eager to learn and discuss with us. Many improvements to the database were done, such as adding an extra working group for Topes de Collantes, a sparsely populated mountain area, which is included in a special mountain program.

Participation with IT staff

The doctor with some IT skills was heavily involved in the project, and also had contact with other IT skilled persons in the city. This, among other things, led to keeping the computer up and running, and the modem working wile we were not there. The computer was used for a range of different tasks, which is good. The tourist industry of the town has brought both skills and hardware to the city, which the statistics department did take advantage of.

Participation with health management

We presented local data on the DHIS to the director, who said that this was something he had always needed. The director was very enthusiastic and looked forward to see what the system could do, but as in many other places, no further initiative was taken by the director to help define his needs for reports etc.

Yaguajay municipal office

General info

Yaguajay is a small town on the north coast, and the municipality consists of 5 working groups in and around this city. It takes an hour and a half to get there from the city of Sanctí Spíritus.

Two statisticians are working at this office. The one in charge of entering into DHIS retired after 2002, but she would train a younger new employee before this. There were some other people with some experience in computers. Not much technical equipment was of any interest, but they had a few old computers in other offices there. The capabilities of these are unknown, but they were obviously outdated. A huge problem in this town is power supply. Contrary to the other sites, where the power is off occasionally due to thunderstorms, heavy rain or just old equipment and lack of maintenance, the entire city of Yaguajay is subject to power savings during daytime. We experienced that the power was only available a couple of hours before lunch, and an hour at nighttimes for many days. This was because central planners had decided that this city could do without power the rest of the time. Cuban power production is based on petroleum, and with the political situation in Venezuela, Cuba has an incredible problem to purchase oil.

Participation with statisticians

The interaction with the statisticians was good in Yaguajay. The problem with the working group structure, as described in section 5.4.4.2, was discussed, along with possible solutions that would be easy for the statistics office. There were also discussions on matters concerning the database and data elements. They found it hard to decide which data to enter for *Consultas Externas* (consults), since this category is not completed with all the elements they used here. We decided that another element, *consultas externas otras*, (other consults) could be used to catch everything not included in the database at this moment.

Participation with IT staff

There was one employee at the office with quite good knowledge of computers. He was introduced to the project, and thought it was interesting. He took part in some of the discussions, and also helped the statistician with technical matters, as saving and loading files, change databases, and other basic functions. He had computer experience to a higher level than necessary for just operating the system on a daily basis though, and is a valuable person in the local project team. There is a computer centre for youth in the town, but we were unable to get in touch with people working there due to our time limit. Cooperation with such centres in small towns can be a good source for both the project and the youth clubs there.

Participation with health management

The management in Yaguajay was more involved in the project than most other places. While not as interested in the teaching process and the introduction to the system, the health director of the municipality was eager to expand the project to other health areas.

With no computers to put in the polyclinics, he decided together with the IT manager from the provincial office that we could install the system in Mayajigua Polyclinic. A very resourceful group, the statistician, manager, and the IT literate at Yaguajay, would make this municipality very interesting for further research. Together with the Mayajigua polyclinic these people make a strong local team

Mayajigua polyclinic

General info

Mayajigua is a small town just east of Yaguajay, and is also a health area under this municipal office. We did not visit this polyclinic during the first roll-out in June, due to lack of gasoline the day we worked in Yaguajay. The polyclinic is part of a UNICEF supported project, and is therefore equipped with a computer with modem connection. We decided to include this polyclinic after recommendations from the provincial and municipal office.

The UNICEF project has been going on for several years, so the people working here had quite a lot of experience with computers. The chief of statistics had in fact developed a range of Microsoft Excel sheets comprising the full information system of the polyclinic. This person is very skilled, and showed a great understanding of the system. Both the director of the polyclinic and the director of one of the working groups have seen the system and are enthusiastic and interested in local use of the data. An impression we have is that people at the polyclinic and municipal offices often have more interest in using data locally and collecting site-specific elements than the national level believe. Here we found a very good team of directors, under-directors and statisticians, which surely makes this the most promising polyclinic so far.

The computer at the polyclinic is placed in a separate air-conditioned computer room. But this computer is old and is lacking memory. On the other side, this polyclinic is connected to the Infomed with an analogous modem, making it the only other site connected with its provincial office except Trinidad on the south coast. The main problem for running the software was the lack of memory. The computer is old, and it works slowly. The project got a late start here, so there was no chance of entering data during summer, and nobody received any training until our first visit in October. But this problem was easily overcome by the local employees, who were fast learners and had computer experience.

Participation with statisticians

The participation from all groups at Mayajigua Polyclinic was the best at all the pilot sites. Software was installed mid-October, together with initial training. More elements were discussed and added, as were the possibilities for importing the local excel system into DHIS. Several thousand of data entries from Excel were entered manually by sorting the excel worksheets after the order in the DHIS. All data were then entered as usual, for 2001-2002. They even created some new elements in the database. The norm so far had been that little was done when we were not present. Here the statisticians had computer experience and used the computers daily for their other tasks. It was therefore natural to also enter the monthly data into the database in the DHIS. Furthermore, the usefulness of collecting data for each family doctor in the database was discussed. They

found the structure good, and unlike other polyclinics they saw the importance of using the data locally. Both family doctor and working group data was interesting here, but none of them for the municipality. As we discussed at the municipality, they agreed here that only data for the health areas was necessary for the municipality.

Participation with IT staff

As the statisticians also functioned as IT staff, the participation of the latter group was obviously good.

Participation with health management

Also the management of the polyclinic was interested in sharing their views and needs, and were eager students when we demonstrated the analysis tools. A pivot table was created and updated with local data and showed to the director of the polyclinic and the director of the working group.

Special notes

This polyclinic is probably the most promising in the Cuban project so far. It has the advantages of skilled employees, is connected to Infomed and mail, which the people who work there fully understands the potential of. Even if other polyclinics and offices will be connected, it may take some time before they can draw from the benefits of uploading new software, database modifications, new data elements, and reporting electronically. This is also one of the pilot sites where the possible output (graphs and pivot-tables) has been shown to directors of both a basic work group and the polyclinic itself. The enthusiasm and constructive discussions derived from this is very promising for Mayajigua polyclinic. They also show initiative by adding and using their own elements, the very idea behind local analysis. They also have a proper computer room, and an UPS, which hopefully will make the computer last longer and less data to be lost due to power cuts and other hazards.

Matanzas provincial office

General info

Matanzas provincial office is located in the city of Matanzas, on the main road to the tourist area around Varadero beach from Havana. It takes around 1.5 hours to drive there from Havana, which should not be underestimated in importance in Cuba. The statistics director could often visit DNE in Havana, and had close communication with the administration there.

The amount of statisticians there is a bit unclear. A special group responsible for the project was created, and we worked mainly with this group. The two persons responsible for the computers made up the group, together with the director of statistics. Contrary to most of the other cases, where we worked solely with statisticians, we worked here with IT staff too. The level of knowledge and understanding in the group was very high, and their participation was of high value for our understanding of the information system and its various forms and reports. The director had two master degrees, and was said to be a candidate for the national office. When we first came they

had 2 computer and a matrix printer in a small room filled up with paper and different obsolete hardware. But a computer room was under construction, when we came the second time this new air conditioned room housed a couple of computers and had a telephone line for modem connection, however just to the Cuban net. Internet could be accessed in a school nearby.

Despite the good conditions for participation and mutual learning the work here was divided and plagued by difficulties. Thunderstorms caused power failures, and important political decisions, including a change in the constitution, made all offices in Cuba close for three days. The staff was very busy, and even if we could work with them for hours in a day, they had to do other tasks all the time, like helping someone with the computers, fixing something, meet someone etc. They had been told clearly that the project could not interfere with normal duties.

Participation with statisticians

The participation with the statisticians was very good, however just with the director. We experienced good cooperation working on the data elements, and the director proposed numerous indicators he used. Special for this office was the understanding for the use of data also, not just the collection and aggregation. A new database was developed here on request by the director, the provincial database. With this he wanted to get data for all municipalities together with their demographic data, and use indicators to do analysis within his province. So at this office the divide between statisticians and management was less. While statisticians at other offices just aggregated data and to a lesser extent supplied the management with their reports, unaware of why those data was important, the statisticians at this office was more analysis-oriented. They also wanted to get computers to all municipalities to get full coverage of the province. While this was the intention for some of the computers donated after the first visit to Cuba, the idea was later abandoned due to the restrictions on expanding the project. As mentioned, Matanzas is close to Havana, and there was a greater degree of control compared to other offices farther away.

Participation with IT staff

The participation with the IT technicians was, as mentioned, very good. They had good understanding of the system, and saw it as their task to take part in developing it for their best. We were joined by one of them when we went to Jagüéy Grande and Ciénaga de Zapata the first time, and he did join the training of local staff there as translator and extra teacher. The IT situation at Matanzas was very good, with one of the new computers from Norway there together with their old, in a new computer room protected from weather with air condition and uninterruptible power supplies (UPS).

Participation with health management

We saw the management very little in Matanzas, except when introducing the project in the very start of the research. But the director of statistics played the role as information consumer too, or at least he knew why and how to do analysis. This way we got valuable input on indicators versus data elements, the need for full coverage etc. The essential dataset as used in the provincial database was populated for last year, because he saw the purpose and possibilities with it.

Jagüéy Grande Municipality, polyclinic and hospital

General info

Originally the only municipality in Matanzas province included in the project, Jagüéy Grande has a municipality office, a polyclinic, and a Hospital, which also serves the rural municipality of Ciénaga de Zapata. It has a medium sized town of the same name, in the most important citric fruit area in Cuba. It is virtually on the main east-west highway, less than two hours from Havana. It was therefore easily reached, and the director of DNE could come by when travelling to provinces east of Havana. All the offices we worked within in Jagüéy Grande was within walking distance from each other.

There were no computers in any of the statistics offices. Whether or not there were computers at all in the polyclinic and hospital is unclear, since we had little interaction with other departments. None of the statisticians had any experience with computers at all, except for one that had one at home from relatives in Miami, and the training went slow in the start. None of the statisticians had any great skills in statistics more than aggregation and easy computation of indicators. They had little understanding of the system, even after a workshop focusing on using local data to produce graphs and reports.

Participation with statisticians

We worked only with statisticians in this town. We had several phases, with installing and initial training, and later a three day workshop. Because of its proximity to Havana and each other, this is the place we have spent the most time in the two provinces. The first times we divided our time between mainly the polyclinic and the hospital, with some from the municipal office joining us. Later we would arrange training sessions with participants from all offices together. One representative from Ciénaga de Zapata which lived in Jagüéy Grande would also participate. At overall, they showed little interest to what the data could be used to. The first essential dataset contained very few elements used by hospitals. This was discussed with the staff there, who suggested elements to add, and learned to do so themselves. This was the only hospital involved while we were there, and the dialogs with the statisticians there were very fruitful.

Participation with IT staff

Even if there were no local IT professionals, we worked together with one person from the provincial office in Matanzas, who followed us for several days the first trip.

Participation with the health management

As we also here tried to involve the management, we were surprised to hear that it was impossible because of lack of time, and at the same time one of the hospital leaders would come into the computer room to check his mail and have a chat with the statisticians.

Special notes

Very little was done when we were not present, contrary to many of the other places. To our surprise they would stop using the system as soon as we finished there, since they thought it was done purely for our research. DNE had told them to not let this project interfere in their daily tasks. We heard that as the changes of the "revolution" in MINSAP was put into practice, the HISP project in Cuba was given lowest priority. As Jagüéy Grande is so easy accessible from Havana and Matanzas, this became clearer here than in other cases. DNE wanted full control of the project and of who we could meet or not.

Ciénaga de Zapata municipal office

General info

Ciénaga de Zapata is a rural municipality in the marshes surrounding the Bay of Pigs. The reason to include the office was mainly a PR stunt, to put a donated computer from a conservative Norwegian newspaper in the infamous Bay of Pigs, where CIA-backed exile Cubans landed in 1961.

The municipality is small, with small villages of fishermen, crab catchers, and former charcoal burners. The surrounding area is swamp and marshes, and except the crocodiles, mosquitoes are a potential health hazard spreading diseases. The transportation is scarce, and there had to be installed 220 V electric current to make the printer work.

This pilot site was not prioritised as much as Jagüéy Grande, as it was small, hard to get to, and the monitor broke down in October 2002.

Participation with statisticians

The two statisticians employed at the office lived in Jagüéy Grande, so after some initial training and entering in Ciénaga, one of them also joined the three day data analysis workshop in that town.

Participation with IT staff

There was no IT staff present. When the monitor broke down in October 2002, it had to be taken to Jagüéy.

Participation with health management

The health director there was eager to see the project succeed, but took no active part in the development himself. A general problem was lack of health managers time.

Appendix D: The terms of reference paper

Johan Vibe, Real Embajada de Noruega

TERMINOS DE REFERENCIA

SUSCRITOS POR LA UNIVERSIDAD DE OSLO DE NORUEGA, LA DIRECCION NACIONAL DE ESTADISTICA DEL MINSAP, LAS DIRECCIONES PROVINCIALES DE SALUD DE SANCTI SPIRITUS Y MATANZAS, EL MINISTERIO DE SALUD PUBLICA (MINSAP) Y EL MINISTERIO PARA LA INVERSION EXTRANJERA Y LA COLABORACION ECONÓMICA (MINVEC), ESTE ULTIMO EN RESPRESENTACION DEL GOBIERNO DE LA REPUBLICA DE CUBA, PARA FACILITAR LA EJECUCION DEL PROYECTO TITULADO: Bare dona å informere Prosjektet er nå veldig offisielt

"DESARROLLO DEL PROGRAMA DE SISTEMAS DE INFORMACION EN SALUD (HISP) EN CUBA".

Jørn Braa

El documento del proyecto se adjunta a estos Términos de Referencia y es parte integrante de los mismos.

1.CONSIDERACIONES GENERALES:

- El proyecto cuenta con un financiamiento externo de 33,800.00 USD, aportado por la Universidad de Oslo de Noruega dirigido a la adquisición de computadora y sus accesorios, software HISP, materiales, transportación internacional y cursos de capacitación, tanto nacional como internacional. El equipamiento y sus accesorios serán adquiridos en Noruega y trasladados a Cuba.

- La Dirección Nacional de Estadística del MINSAP asegurará un aporte financiero de 115,000.00 Pesos Cubanos por concepto de pago de alojamiento, transportación, costos de capacitación, materiales de oficina, costos de servicios. .

- Las Direcciones Provinciales de Salud de Sancti Spíritus y Matanzas, garantizarán un aporte en moneda nacional de 105,000.00 Pesos Cubanos por concepto de pago de salarios.

- El proyecto se desarrollará en las Provincias de: Sancti Spíritus en los municipios de: Fomento, Sancti Espíritus, Yaguajay y Trinidad y, en Matanzas en los municipios de: Jagüey Grande y Ciénaga de Zapata. De los resultados que se obtengan en las mismas el proyecto se extenderá al resto del país.

- El proyecto tiene una duración de un año y medio.

- La contraparte oficial del proyecto será la Dirección Nacional de Estadística del MINSAP,la que se relacionará con la Universidad de OSLO de Noruega, como su contraparte extranjera.

- El proyecto cuenta además con la participación del MINSAP y el MINVEC, para facilitar su ejecución.

- El proyecto cuenta además con la participación del MINSAP y el MINVEC, para facilitar su ejecución.

2.OBJETIVOS:

2.1.OBJETIVOS GENERALES

- Apoyar el fortalecimiento y el desarrollo extensivo del Sistema Nacional de Información de Salud de Cuba, dando prioridad al análisis y uso local de la información.
- Desarrollar en Cuba un fuerte nodo en la red del HISP y hacer de Cuba el hospedero de la versión español del software del HISP, respecto a América Latina.

2.2. ESPECIFICOS

1. Identificar los principales blancos en las acciones de salud más importantes, sus indicadores y el conjunto de datos esenciales mínimos para ser incluido, registrado e informado a través del sistema a los distintos niveles en el contexto nacional, provincial, municipal, área de salud y servicios locales de Salud.
2. Validación, análisis y uso de la información para la dirección y la toma de decisiones.
3. Desarrollar una aplicación de base de datos basada en el software del HISP que abarque todos los niveles.
4. Desarrollar los recursos humanos y la capacidad institucional dentro del área de sistema de información de salud, las tecnologías de la información y la comunicación (ICT) y del manejo de las bases de datos relacionadas dentro la estructura del Sistema Nacional de Información de Salud. Tanto nacionales como internacionales.

3. RESPONSABILIDADES DE LAS PARTES:

UNIVERSIDAD DE OSLO. NORUEGA.

- Garantizará la contribución externa del proyecto en su carácter de contraparte extranjera y de entidad donante, en un monto de 33,800 USD.
- Designará como coordinador del proyecto por la parte Noruega al Sr. Jorn Braa, Profesor de la Universidad de Oslo.
- Impartirán los cursos de capacitación en las fechas prevista en el proyecto y en las provincias que participan en el mismo.
- Supervisará la ejecución del proyecto y la utilización de los recursos aprobados.

- Participará en el monitoreo de la ejecución de las diferentes etapas del proyecto.
- Participará, previo acuerdo y aprobación expresa de la contraparte cubana, en las acciones de divulgación de los resultados.
- Realizará los informes correspondientes sobre la marcha del proyecto de conjunto con la contraparte oficial.

DIRECCION NACIONAL DE ESTADISTICA DEL MINSAP.

- Designará como coordinador principal, encargado de su ejecución y las coordinaciones a que hubiera lugar con la Universidad de OSLO DE Noruega al Dr. Eduardo Zacca. Director Nacional de la DNE.
- Garantizará las facilidades necesarias para el control conjunto sobre la adecuada utilización de los recursos.
- Elaborará los informes narrativos que sobre la ejecución del proyecto le sean requeridos por la Universidad de OSLO de Noruega, la Direcciones de Relaciones Internacionales del MINSAP y el MINVEC.
- Aportará los recursos humanos e instalaciones necesarias para el desarrollo del proyecto.
- Brindará la información necesaria sobre los resultados de la ejecución del proyecto.
- Participará, previo acuerdo y aprobación expresa con la contraparte Noruega en la divulgación de los resultados y de las ventajas y beneficios que pudieran derivarse .
- Entregará información financiera sobre la ejecución del proyecto al MINVEC el día 20 de los meses de Marzo, Junio, Septiembre y Diciembre.

DIRECCIONES PROVINCIALES DE SALUD DE SANCTI SPIRITUS Y MATANZAS.

- Brindarán las facilidades necesarias para la ejecución del proyecto, así como el control correspondiente para garantizar la adecuada utilización de los recursos.
- Aportarán los recursos humanos, materiales y financieros necesarios para el desarrollo del proyecto.
- Brindará la información necesaria sobre los resultados de la ejecución del proyecto.

MINSAP

- Participará en el control y ejecución del proyecto y en la evaluación de los informes narrativos financieros.
- Participará, de conjunto con la Dirección Nacional de Estadística y la Universidad de OSLO, en la divulgación de los resultados.

MINVEC:

- Brindará todas las facilidades para la ejecución del proyecto en el marco de la legislación y las disposiciones cubanas vigentes respecto a la colaboración internacional.

- Ofrecerá los servicios de la Empresa Ejecutora de Donativos (EED) acreditada ante la aduana para trámites de importación y extracción de equipos importados, asumiendo la manipulación y transportación interna.
- Se responsabilizará con la obtención de las exenciones de gastos correspondientes por concepto de aduana.
- Brindará las facilidades, de acuerdo a la legislación cubana, para la tramitación de las solicitudes de visas que requiera el personal de la Universidad de OSLO , para la buena marcha del proyecto. La solicitud de visas deberá indicar que la visita se realiza en el marco del proyecto. La permanencia del personal de la Universidad de OSLO está en dependencia de los requerimientos del mismo.
- Facilitará, apoyará y participará en las acciones de visibilidad que se desarrollen en el marco de este proyecto.
- Realizará supervisión y control del proyecto.

4. **VIGENCIA:**

Estos Términos de Referencia estarán vigentes hasta la culminación del proyecto.

Cualquier incumplimiento y/o discrepancia entre las partes que puedan surgir en la ejecución de este proyecto se resolverá de forma amistosa entre las partes.

En Ciudad de La Habana a las 4 días del mes de junio 2002

Por la UNIVERSIDAD DE OSLO DE NORUEGA

Por la DIRECCIÓN NACIONAL DE ESTADISTICA

Por el MINSAP

Por el MINVEC

Por la DIRECCION PROVINCIAL DE SALUD DE MATANZAS

Por la DIRECCION PROVINCIAL DE SALUD DE SANTI SPIRITUS

Appendix E: The HICSS article

The following article is based on the same study as the thesis, and was a product of early discussions when returning from Cuba. It is approved for the 37th Hawaii International Conference on Systems Sciences (HICSS'37), and will be presented there January 2004.

Evaluation of a Bottom-up Action Research Approach in a Centralised Setting: HISP in Cuba.

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Abstract

There has been a high rate of failure in the implementation of information systems in developing countries. Participative approaches have received a lot of attention as a way to ensure more appropriate systems with a greater rate of success. The authors of this paper spent 4 months working on designing and implementing a health information system as part of the Health Information System Program (HISP) in the Cuban Ministry of Health using this type of approach. This paper describes the experiences there. The HISP has proven to be a relatively successful information system in India and in several African countries, aiming at empowering local health management and improving information use at the local level. The primary contribution to the current literature on participative approaches is the lessons learned in trying to use this approach in a highly centralized setting. General implications for system development and collaboration in Cuba are also discussed.

Introduction

The benefits of designing information technology systems through participative approaches have received a lot of attention. This approach has been recognized to be especially beneficial when used in developing countries. This paper highlights some of the lessons learned from using this approach within the highly centralized setting of the Cuban Health Services. The paper also aims at providing insight into the Cuban healthcare system and the environment in which health information systems must be developed and implemented, a little explored issue in the current literature.

The paper will first give an introduction to the field of Health Information Systems (HIS) in developing countries, relevant theoretical aspects, and the Health Information System Program (HISP). Secondly, a description of relevant characteristics of Cuban society will be given in order to provide the reader context. The project work done in Cuba will then be covered. The paper will conclude with an evaluation of the approach used.

Health Information Systems

A Health Information System (HIS) can be defined as, "a set of tools and procedures that a health program uses to collect, process, transmit, and use data for monitoring, evaluation, and control" [1]. An HIS is one of the many tools that can be used to improve a healthcare system, but it cannot stand alone as a solution to all of a system's problems.

The 1978 World Health Organization (WHO) conference in Alma Ata, Kazakhstan, concluded that primary health care (PHC), essentially a decentralized system with a focus on preventative care, is the most suitable way to organize health services. The basic tenets are that health services should be offered and managed from small demographic and geographic areas to best achieve good communication with higher and lower levels, be close enough to communities to understand and act upon their problems, and be able to handle decentralization of resources and decision making. A clearly defined geographic area with a population of 30,000 to 500,000, often called a district, is considered to be an optimal size in regards to the previously mentioned targets.

Within this context, an HIS that captures and uses data at a local level is of the utmost importance. It can greatly assist in making appropriate healthcare policy at all levels within the type of decentralized system suggested by the WHO. To successfully achieve this, Amoono-Lartson et al. suggest, "bottom-up," instead of, "top-down," planning in order to correctly assess the needs, resources, and opportunities at the community level [2]. In this way, health service planning can incorporate the viewpoints from the local level rather than solely the needs as seen at the national level. It is in drawing on these ideas that the project in Cuba was conceived.

Theoretical framework

In terms of the theoretical fields that the study seeks to develop, the focus is on user participation and action research. Theories concerning information collection are also pertinent due to the enormous amount of health data collected by the Cuban government.

Action Research

Action research (AR) is a method that was first explored during WW II. Within AR democracy and user participation are seen as key in achieving goals. Stakeholders participate actively together with researchers to create a democratic process in which everyone can contribute. AR researchers believe that there is great potential in allowing users to analyze their own situation and give their valuable knowledge and insight to the researchers. A core principle is democracy, as the aim is to democratize the research process through inclusion of local problem owners. The context and various aspects of a given problem are often best known by stakeholders, and combining their knowledge with researchers' knowledge often allows the implementation of the most appropriate method of addressing the problem. Under this approach knowledge flows in both directions.

Often stakeholders have lost their ability to objectively view their own situation and see possibilities for change. This however is not in contrast to the belief that stakeholders know their own situation best. A main contribution of the researcher can be to act as a friendly outsider [3] who can loosen up tensions between stakeholders and bring in a fresh viewpoint to assist them in moving from positions in which they may be stuck. As a, friendly outsider, another key contribution of the researcher can be in helping stakeholders communicate with each other.

Constraints of user-participation

Heeks, Mundy and Salazar [4] points out the fact that participative approaches have received the status of a, "magic bullet," that will always be beneficial in system development. In fact they are still beset with problems. User-participation techniques are, according to Heeks, unlikely to work well where:

- users lack information about participative techniques
- the objectives of senior staff is not to share power and the values of the organisation are authoritarian and hierarchical
- users lack the skill and confidence necessary to engage in participative processes
- the management style and organisational structure of the organisation are highly centralised.
- the organisation lacks the time and money to invest in participative approaches.

Information as Symbol

Feldman and March [5] suggest that organizations capture much more data than required to make informed decisions. The organizations often do not know exactly what information they need to make decisions, and request more

information even after decisions are taken. Information gathering comes to be seen as a symbol on a good decision maker, even if there is not necessarily a connection between the amount of information gathered and the quality of the decision. The skills of the decision maker are regarded as a product of how much information he collects, and how early he can obtain fresh information.

HISP

The Health Information System Program (HISP) is a research and development project that is collaboration between the Universities of Western Cape (South Africa), Eduardo Mondlane (Mozambique), Oslo (Norway), Indian Institute of Management, Bangalore (India) and the Departments of Health in South Africa and Mozambique. It began as one of several projects to reform the health information system in South Africa after the fall of apartheid. As a result of its relative success, the software that was developed (DHIS) and an essential set of data elements became national standards in South Africa in 1999. The District Health Information Software (DHIS) is a database tool for capturing data elements, that is, medical incidents and figures of managerial interest at district level and lower. It also has a wide range of options to submit, compare, and analyse this data. However, the software is flexible so that it can be used at any level desired.

The philosophy behind the project is to empower local management, and create the ability to analyze and use information locally. HISP has developed as a network aiming to use information technology to improve the health systems of developing countries. The project is funded completely through aid. The software is based on open source, and this enables the ever-larger network of countries using it to contribute in a meaningful way to the improvement of this non-profit alternative to health information systems. It has been translated into Portuguese and Spanish, and has been implemented to some extent in Mozambique, Malawi, Tanzania, India, Mongolia and Cuba, with several other countries showing interest, such as Angola, Brazil, the Dominican Republic and Guatemala.

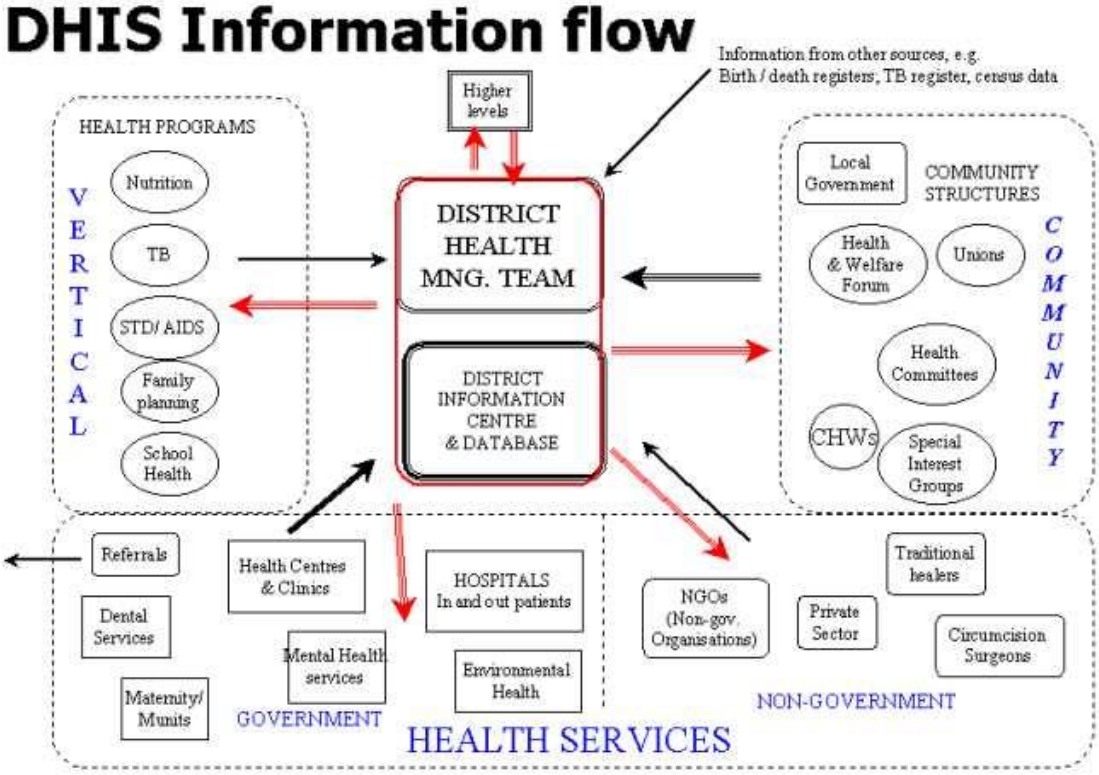

Figure 1 The information flow promoted by the HISP and the DHIS software. Information is used locally by a district health management team. The reality in many countries is information is often divided between many different organizations and departments instead of being analyzed as a whole at the district level.

The HISP focused on strengthening the health system at district level, as proposed by the Strategic Management Team on Health Information Systems in Western Cape [6]. HISP

thus promotes the use of information at the local level for PHC. Raw data is collected from all relevant entities within a district, and thereafter the software enables easy use of indicators and analysis tools. Action can then be taken locally, on the basis of an evaluation of local data and knowledge. This is in stark contrast to how health information systems often work in developing countries. Data is collected and submitted to higher levels than the district. Often this results in the loss of the ability to evaluate information within the context of its origin, with variations that are significant at the local level becoming insignificant in national level evaluations.

Action Research and HISP

The processes are strongly influenced by the ideas of participation, following the Scandinavian tradition of action research [7] [8] [9]. In South Africa the friendly researcher role was combined with an informal mechanism for reporting bugs and requesting new functionality. The process was informal and based on improvisation, giving anyone, regardless of position in the health hierarchy, full access to the development team [6].

As in the theory of AR, context sensitivity is crucial for HISP. One must take in consideration the specific context to where the system is developed or adapted to succeed. As discussed later in this paper, this is what we here will try to do after our experiences so far with Cuba.

As the HISP software is intended to be used at the district level it is of the utmost importance that the software is developed with collaboration at the district level. In Cuba, the researchers, together with another researcher involved in HISP since its beginning in South Africa, followed this path of local development. The senior researcher, also the tutor of the authors of this paper, had experience from starting up similar projects in many countries, most notably in South Africa, Mozambique, India and Mongolia.

The setting up of a database and the identification and implementation of an essential set of health data elements and indicators in Cuba was seen as a development process, even if no coding of software was needed. It was therefore planned to do system development with strong user participation. A bottom-up approach was followed, focusing on the Cuban equivalent of districts and provinces. Problem areas in each district were identified together with local staff, who also participated in the development of databases. Training took place locally and an effort was made at each pilot site over the span of several months to develop a culture of using the software in informed decision making.

Cuba

Cuba, like many developing nations, has a struggling economy, is unable to pay its debts, and is in need of significant improvements to infrastructure. However, Cuba stands apart from most developing countries in some key areas. It offers free, quality education to the University level, resulting in a society with a very high level technical knowledge and ability. It also offers free health care and has succeed in meeting health standards in terms of life expectancy and infant mortality that are comparable to countries such as the United States.

The idealism behind these unusual characteristics is a result of the goals of the Revolution which took place in 1959. The Cuban Revolution, led by Fidel Castro, overthrew the last in a series of inefficient and corrupt dictators. Castro and his followers nationalized land and industry, much to the chagrin of American investors and wealthy Cubans. This resulted in the US gradually cutting sugar quotas, which segued into the strict US embargo against Cuba still in effect today.

With the help of Soviet technical assistance and subsidises, the country developed its industry, agriculture, health, and education systems during the 60's, 70's and 80's. The fall of the USSR created drastic strain on every aspect of the Cuban system as 5 billion dollars a year in Russian subsidies disappeared.

Today the economy is still centrally planned, with some private enterprise allowed in recent years. Almost total government ownership gives the government the ability to spend all the country's assets in whatever manner desired. While the government is theoretically a democracy, no opposition is tolerated. The political system became somewhat less stable after the fall of the Soviet Union, as hardship in everyday life increased. The US embargo, as well as external and internal dissent, threatens the current political system.

The embargo has had severe effects on the Cuban economy. It effectively closes all markets for Cuban exports such as sugar, citrus, coffee, oil, and minerals. The import of goods, including foodstuffs, medicines, and technical equipment is also almost impossible. The US Helms-Burton Act of 1996 essentially keeps Cuba from being able to participate in international trade. As such, the main industry is tourism, accounting for a substantial part of GDP, and the government is working on developing it further. Unfortunately, the legal system makes foreign investment risky and generally unprofitable. Foreign investments that exist are mostly related to tourism and mineral extraction.

Unfortunately, it seems that the government pumps significant funds into some sectors while ignoring others almost completely. They have made the remarkable achievement of supplying all schools, even those with only one pupil, with computers. Conversely, the health statistical branch in which the HISP takes place only has computers in offices at the national and provincial level, 16 offices in total. Programs that are not seen as neatly fitting into the centrally planned strategy of economic development are often down-prioritized, regardless of their actual importance.

General implications for IT projects

Issues related to centralism and control in the Cuban system are of central importance and will be discussed later. First, it is relevant to point out some other factors specific to Cuba from the system development perspective. Computers in Cuba are scarce and those that do exist are very outdated. The humidity and frequent blackouts are also detrimental. The lack of computers, air-conditioning, and sufficient power supply are directly caused by the economic situation.

The US embargo unarguably succeeds in its goal "to isolate the Cuban economy and deprive it of U.S. dollars" [10], and this has had a direct effect on ICT and system development. All software and hardware from the US, and foreign branches or partners of US companies, is illegal to export to Cuba. This applies to Microsoft products as well as freeware. Figure 2 shows the message we got when trying to download Java Development Kit, freely available to everyone not in certain countries, as Iran, North Korea and Cuba.

Even though youth grow up with computers in schools, the economic situation is a substantial barrier to true computer literacy. Complete computer illiteracy is high among adults. Lack of resources such as paper and ink cartridges mean that printing as known in many societies is unheard of.

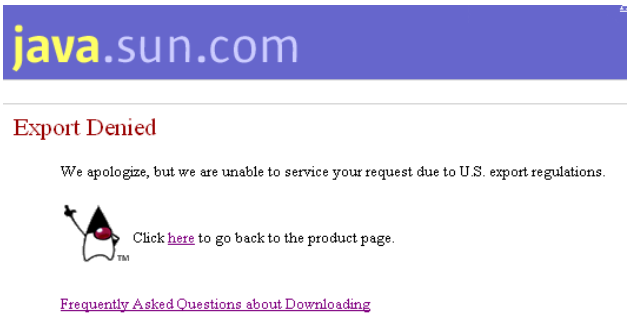

Figure 2: A snapshot of the java homepage, showing how free, leading technology is unavailable to Cubans. "We apologize, but we are unable to service your request due to U.S. export regulations."

The internet is also highly regulated, meaning that only high officials and some schools have access through proxy servers requiring access for international communication. Even approved national servers can be hard to reach, especially in rural areas. Hotels and "telephone kiosk's" offer internet connection on 56 k modems. It is unclear if this is open for Cubans too, since hotels are usually a tourist only area. Regardless, few Cubans can afford to pay the common rate of 5 US dollars for half an hour connection, equivalent to half a month's wage.

The Cuban Health System

Despite the many problems in Cuba, the health system is far superior to countries across the developing world. One of the goals of the Revolution was to improve the health system, and to offer it to all people. Over the years, clinics and hospitals were built, and medical staff has been educated. As a result of these efforts, Cuba has situated itself as one of the best countries in the world regarding health services. This has led to excellent infant mortality rates and life expectancy and the eradication of many illnesses. The number

of physicians per 100 000 inhabitants was 530 in 1997 [11], in contrast to 413 in Norway and 279 in the US. The figures for nurses and dentists are not so overwhelming, but far better than countries in a comparable economic situation. The main death causes in Cuba are hart disease, stroke and cancer, as in a developed country. As the Cuban says, “We live like the poor, but die like the rich”.

Although yellow fever was eliminated as early as 1901, the various pre-revolutionary governments did little to keep up the work. After the revolution however, Cuba has eradicated polio (1963), malaria (1968), diphtheria (1971), measles and mumps (1997) and leprosy (1998). Other diseases which have been eradicated include cholera, bubonic plague and rubella. Cuba has a strong biotechnical research environment, and holds 400 patents in this field. Cuba is also taking the treat of HIV seriously. Everyone infected are given treatment and education at special sanatoriums, while receiving full salary, where they are free to stay after the initial period.

Cuba has no private health institutions, and is organised as shown in figure 3. The health minister has several sub-ministers who run the different branches of the health system. Except from the national and provincial hospitals and some clinics catering to tourists for dollars, each unit is administered from the Municipal office. A municipality is the Cuban counterpart of the WHO-defined health district. The basic working group and the family doctor is an interesting aspect of the system. The basic working groups consist of 10-30 family doctors, where each doctor typically serves a small community or a neighbourhood. Considering the scarce resources available, this system is quite impressive.

Information use in the Health Services

The information flow follows a hierarchical structure in parallel to the health administrative units. This system is governed by Dirrecion Nacional de Estadisticas, DNE, in Havana. To administer this parallel system of statistics, there are many thousand statisticians employed, typically 4-7 at a policlinic, which there are 440 of, and also at other health units and at each administrative level. The information system is very extensive, with a total of 67 subsystems with 2027 variables [12]. These subsystems and variables are reported with different intervals; daily (e.g. infant mortality rate, all the way to the national level), weekly, monthly (e.g. basic health care data from policlinic to municipality), and quarterly (e.g. hospital data from province to national level). The family doctors report every day to the policlinic, together with the specialists serving there. From the policlinic, the statistical office makes reports to the director of the policlinic and for the Health Area (policlinic with its working groups and specialists) as a whole. This takes place every month. The municipality office of statistics also get data from hospital, home for pregnant, home for elderly, dental clinics etc. in that municipality. The municipality offices of statistics make reports to the administration at the municipality level, and also report all the data to the provincial statistical offices. At that point the same procedure is repeated before the data finally reaches DNE.

The health system is officially decentralized, and each level is in fact administered by the local government. But the information use is not as decentralized as the structure implies. It was experienced that most statisticians at policlinic and municipal level have little or no knowledge of what is “good” or “bad” data, of what is useful or useless. The programs used are made at national level, and this follows the soviet tradition of a strong centrally oriented administration. It was said at the national office, people farther down in the system, even directors, don’t have the knowledge or power to choose appropriate data. Even if data can be requested by directors of hospitals and clinics from their respective statistical offices, it was found that most data is collected because it was requested from Havana.

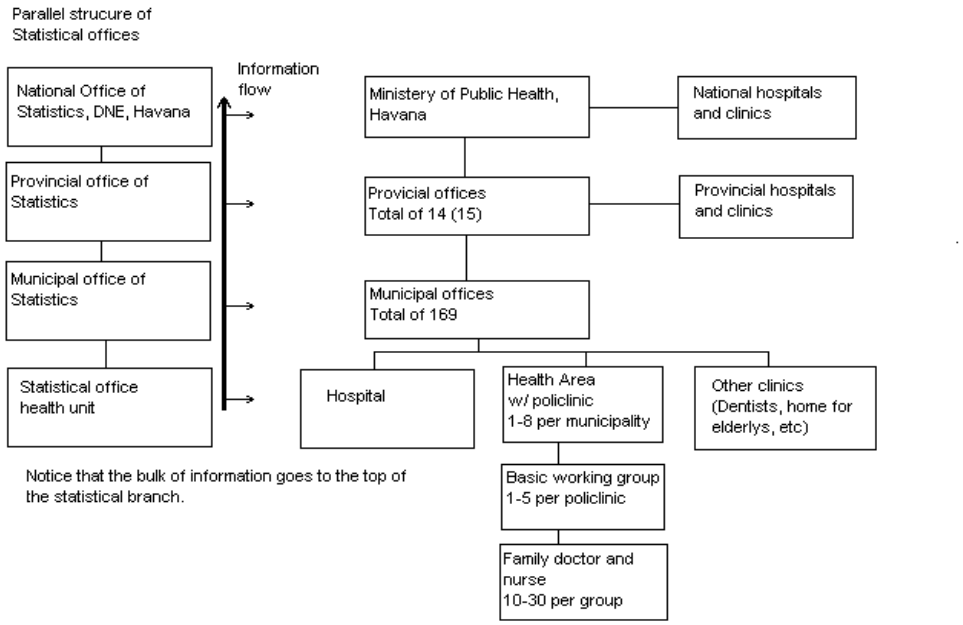

Figure 3. The chart shows the Cuban health structure. The parallel branch of Statistics is where the HISP project is rooted.

The extensive amount of variables collected is apparently used mainly to document what is done, and not what needs to be done. Too much data is collected, and for the wrong reason. An example is the Cuban obsession with the Infant Mortality Rate, reported daily all the way to national level. The reporting of this single data element is a ceremony obviously not only for practical reasons, there is no way to meaningfully analyse trends on this on a day to day basis at any level, much less in a single hospital with less than five incidents in a year.

Infant mortality rate is also a WHO indicator of great international interest, used to determine the status of the country's health system. Cuba has a long history of promoting its achievements in health care and it could look like some information gathering has as its goal to provide political leaders, both nationally and internationally with the right figures, and create an impression that the information is used in decisions and shaping politics. Information gathering is thus a symbol on the quality of the health services' ability to gather information for decisions. However, this leads to the organization gathering more information, and more often, than can be justified according to decision theory terms. The strong information focus in Cuba can thus be seen as a symbol of control for political leaders, and for good informed decision making for the international community. The current use of information has a descriptive focus, it is used to document the situation, rather than to change it. Some major changes occurred in the ministry of health due to this. As described later, there was some change of ministers, among other things, to change the way information was used.

The new health minister has announced a shift to a more preventive health information system, where information should be used locally to prevent, rather than document, health issues. As we will see later, this did not automatically fit well with the theory of HISP.

Summary of HISP project in Cuba

In October 2001 Cuban delegates visited Norway in search of possible collaboration projects and they were presented the HISP program at the University of Oslo. They found the program very interesting, and soon a future collaboration between Ministerio de Salud Pública (MINSAP), the Cuban Ministry of Public Health, and the University of Oslo was planned. In June 2002 a senior researcher from Oslo and the two authors went to Cuba to start the Cuban HISP project. The Cuban institution involved in the project is the Dirección Nacional de Estadísticas (DNE), the national statistics office at

the MINSAP. The national director of health statistics is the leading authority at the DNE, and the Cuban responsible for the collaboration project. A Norwegian donation of 11 computers in May 2002 made it possible to realize the project, and later another 60 computers have been donated to scale up the development process.

First round of fieldwork

In June 2002 field studies were conducted in the two appointed pilot provinces, Matanzas and Sanctí Spíritus, to gain knowledge about information flow and working routines at the different levels in the Cuban health hierarchy. Based on these fieldtrips and discussions at the national level a database system was designed to use as a prototype in the pilot places. Two provincial statistical health offices, six municipal offices, two polyclinics and a municipal hospital were chosen as pilot sites within the two provinces. A small essential dataset of 35 elements were chosen for easy implementation and to get some basic data for evaluation of the project. After designing the prototype at the DNE in Havana, the Norwegian senior researcher signed a terms of reference paper with the DNE, MINSAP and Ministerio para la Inversión Extranjera y la Colaboración Económica (MINVEC), the department for Foreign Investment and Economic Collaboration. When we returned to Norway at the end of June 2002 the Cuban HIS project was official and plans were made to continue the project with Norwegian collaboration for a minimum of 1 ½ years.

The July revolution

In June 2002 it was planned with the DNE that the two authors would return in September to work in the project for three months focusing on implementation of the system in the two provinces. It was also discussed that the senior researcher would return in November and work in Cuba for 3-4 months as project coordinator. During July 2002 there was a drastic political change in the MINSAP, and the health minister and most of his vice-ministers were fired and replaced. New visions and strategies on how to improve the health system were developed, and part of this new strategy was to reduce foreign investments and collaborations. The new minister wanted to shut down the project, but the National Director of Statistics managed to keep it alive. Still, this political change affected the way forward for the HISP project with new restrictions on the extension on pilot sites, restricted involvement of Norwegian project coordinator and a general down prioritization of the project. After some intensive discussions by e-mail between the two collaboration sides in August 2002, the Cubans decided that the senior researcher was not allowed to stay in Cuba for more then 2 weeks at a time, in contrast to the planned stay of 3-4 months. The two authors were allowed to stay for the planned three months, and this differentiation between master students and an authority-person like the researcher with lots of international experience could indicate a fear and skepticism of foreign involvement, a professor is obviously a bigger risk to the Cuban system than two master students when it comes to power to change and interfere.

Second round of fieldwork

In September the two authors started the implementation process, together with training of staff at all levels. Local workers at health units, at the municipal offices and the provincial offices were encouraged to participate in the design process to make the system more tailored for each place and to secure local ownership to the system. In this period we had a strong focus on local implementation and the national level in Havana was not much involved in the process. In November 2002 the DNE complained that they had lost control of the development process, they wanted a more centralized approach and they especially disliked that local workers were getting more skilled in the system than themselves. After discussions at the DNE with the National Director of Statistics and the Norwegian senior researcher, there was a shift in the development strategy towards a more centralized approach. DNE in Havana froze the local development processes in the two provinces and the focus was now 100% on developing a database system that suited the needs of the top two levels in the hierarchy, the national and the provincial. The DNE stressed the need for more knowledge transfer at the national level, and we started to design this database at the DNE with participation of the national staff.

Dissolving the project

In December 2002 the two authors finished their project period and another Norwegian master student arrived in Cuba to continue the

project process. A national hospital database was developed during the first months of 2003, a database tailored for the national and provincial levels. In April 2002, the DNE decided to roll out the hospital database to all 14 provincial offices, equipping each office with two of the donated computers. The Norwegian student worked in Cuba until June 2002, and by that time the Cuban interest for DHIS was totally gone. Central planners had decided to develop entirely new web-based software, in Cuba, with the latest technology available. How this will be done with the scarce resources and the centralistic nature of Cuba will be very interesting.

Evaluation of the approach

The research and development approach followed by the Norwegian participants in the HISP project was focused on a too low level. We went out to the municipal and provincial offices after a short period establishing the project in Havana, and in the second period we visited Cuba, we concentrated most of out time out in the field. This lead to several implications;

Firstly, Cuba is strongly centralized. The information use at the lower levels in the health system is scarce, and most data are reported up to the next level. We were told at the national level at even if the structure is decentralised, staff at the provinces and municipalities don't know what data is good or not, or have any skills in determining useful new elements to collect. We found that this is partly right. In the statistical branch, there was no culture of information use, and when asked of what elements and indicators they thought were important and useful, they would always point to the centrally decided information subsystems, however unable to explain why they were important except that Havana wanted them. This is a legacy of 40 years of strong centrally planning, and it will take a long time to change this. But we also found that some data were collected in addition of the official reports. They called this "datos negros", black data. They collected this at some health units to cater their own needs. This is a good example of local initiative. As in a hierarchy of local universalities [6] [13], these data elements make up their local data set together with data elements in the provincial, national, and international systems. These local elements are important to keep the standardized systems as small as possible. But the use of local elements was not encouraged by the above levels, and we did not find them in all pilot sites.

Secondly, staff down the hierarchy, especially at municipal and health unit level, didn't know what the project was about, what the goals were, and why we were working with them. They were not told from above, and they did not ask. As long as we were there, we cold tell them and inform them, but when working in Havana or another province, they project would usually stop. The people we worked with are used to get orders from above.

Thirdly, the different parallel vertical structures in the health system are strong. This means that it is very difficult to cooperate across structures. Working within the statistical department meant that it was very difficult to communicate with the information technology department. When dealing with the parallel vertical structures, it is imperative to move from the top down and to gain political support behind the interactions with the different actors in the health system. When working in the provinces and municipalities it was hard to arrange meetings with other important groups such as the strategic planning group or the administration. These problems tend to ease farther down in the hierarchy as well as geographically farther from Havana. This freedom of interaction take the shape of a mountain as shown in figure 4, where the foot of the mountain is broad and allow interaction with other departments, while closer to the top and Havana this interaction was harder. Also physically distance from Havana is important, since communication and transportation problems prevent close supervision far from the capital and highways.

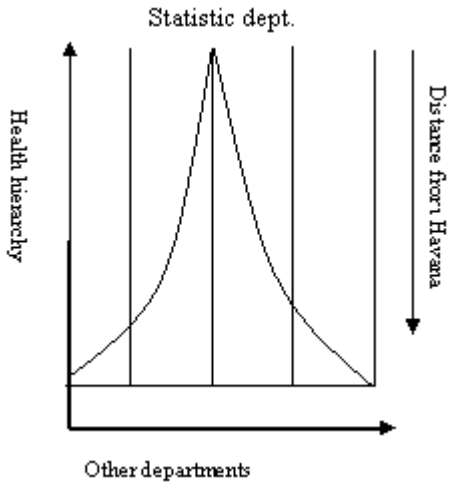

Figure 4 shows expanding possibilities for cross-structural collaboration farther from Havana and at local level. Policlinics in rural areas tend to be more self-governed and offer better possibilities for participative research and development between departments.

The main contact from the start was the Director of Statistics. He had great responsibility for the project at all levels and was accountable for his handling of the project to those above him. As mentioned earlier, foreign projects cause some degree of suspicion in Cuban political life, and this can be understood in light of their peculiar history. The director was personally responsible for the actions of the authors of this paper and his trust in them was evidenced by allowing them to work fairly independently outside of Havana.

In the summer of 2002 the Minister was replaced and this changed things considerably. The way politics work in Cuba creates a culture of fear. Ministers can be replaced instantly, together with all their sub-ministers. The Director of Statistics was now accountable to a new Minister of Health and allowing foreigners too much freedom in their work in the health system could have compromised his position in the eyes of the new Minister. This resulted in a reduction of freedom in working at the lower levels.

It is important to remember here that the health system is Cuba's pride. It is the child of the revolution, and the Cubans are proud of competing with the developed countries in regards of health service achievement. And foreign projects working in this health system at a low level outside Havana's control, even without creating much-needed hard currency, is a potential dangerous situation for the person in charge. He needs to have full control over the situation, and be updated on the latest news. This can be difficult enough working in the rural areas in Cuba. The best way to control that nothing "dangerous" happens, is to limit the possibilities the researchers had to interfere in the normal life of the health units. People were told not to spend time on the project, and it proved impossible to meet directors outside the statistical department. As this is the reality in Cuba, the bottom-up approach followed will not succeed without political support at the highest level first.

All information systems, paper based or computerized, are developed in Havana. The systems are developed in the DNE, and some software is developed centrally in a special department of the ministry of health. This is the way it has been done the last 40 years, and participative development theory was unknown in the statistical department. The ideas and benefits of such an approach were not easily understood by the Cubans.

Benefits of a participative bottom-up approach

The approach yielded information which could not have been obtained in any other way. And this is the core of the methods. The focus on participation with stakeholders at local level, the people who will use the system, will create the necessary knowledge to the make the system work, and work right. There were many discrepancies between the database first set up in Havana and the reality out in the provinces. For example, names in the national database could be like GBT 1, GBT 2 and GBT 3 for three basic working groups, but in the municipality and policlinic where the data for these groups were collected, the names would be GBT North GBT South and GBT Central. These smaller units are never used in national analysis as the DNE use data aggregated at a much higher level, but locally they have developed more intuitive names for all these units.

We also found that data elements included in the essential dataset were sometimes understood differently from place to place, and they did not know what figures to put in the right place. This would have been realized much later using a top-down approach. The approach used revealed how things was at the local level, and to a certain degree local staff were involved in identifying and addressing problems and opportunities. Some very enthusiastic people, at all levels, shared the vision

of a computerized system which eased the local use of information. From the national level it was made understood that they did not exist! Some people really had knowledge about what data was good or not, and wanted to use it. These people contributed to the project both in terms of daily organization of the researcher's stay and through discussion about different relevant issues, and their participation led to a tremendous amount of ideas and knowledge. They staff who have now worked on this project have got a feeling of ownership to the HISP. This is important to acquire sustainability at each site. By working as far down as the health units, tailored solutions could be made at each level. This was especially important where the enthusiastic people worked, where more than the initial training could be done and the software could be utilized to their own needs. This cultivation is an important aspect both to get good standardization of data elements and promote local use of data and development of local universalities.

The findings of the study fit well with the writings of Heeks, Mundy & Salazar [4]. As recalled, participative approaches are less likely to succeed if;

- users lack information about participative techniques

Some people at local level in the statistical department had even little knowledge about statistics; they just aggregated and forwarded their daily numbers.

- the objectives of senior staff is not to share power and the values of the organisation are authoritarian and hierarchical

The senior staff in Cuba is afraid of loosing power and control. Even if they officially divert power down the system, they need control to be able to document their work and secure their job.

- users lack the skill and confidence necessary to engage in participative processes

Many people in Cuba are greatly skilled and have great confidence, but are unable to participate due to restrictions from their manager.

- the management style and organisational structure of the organisation are highly centralised.

This is true in Cuba. But it was less obvious the farther away from Havana. Poor transportation and infrastructure creates decentralised units where people have to take decisions themselves. Participative approaches in these nodes tend to be very fruitful

- the organisation lacks the time and money to invest in participative approaches.

There were generally far too many people working in statistics to keep them occupied with work. But lack of time was the explanation why collaboration with other departments was unfeasible.

Other countries in the HISP network have had similar approaches, but with different results. In Tanzania and Malawi staff at all levels could agree on decentralizing power, but the administrative structure was not strong enough to put it into action when HISP researchers were not present. In India the bottom-up process met problems since a superior level don't see the benefits of the system before every node under it uses it. And in India there are so many hierarchical levels that this was a major problem. This was also a problem in Cuba, because the project was not allowed to equip all municipalities in one province with computers. The provincial director saw the potential and wanted full coverage of his province, but was unable to convince the national office without the output from the software on the whole province. It was a "Catch 22". [5]

Conclusion

In light of the specific situation in Cuba it is necessary to adjust the approach of the HISP. Nevertheless, following the, "Cuban way," proposed, is not a possibility within the time frame or the philosophy of the HISP. The Cuban approach is to complete systems development in Havana and then impose them at the provincial and municipal level. The study also shows that

[5] Catch 22 is a military term from the novel with the same name by Joseph Heller. In the book, you can only go home from The War if you are crazy, but saying you are crazy proves you are sane and trying to get home, hence locking the situation to keep you in the war.

participative development is likely to be very fruitful at health units not often supervised from Havana. This paper proposes a middle ground solution between the HISP bottom-up approach and the Cuban top-down approach. The last phase of the project was completed in this manner to try and accommodate the concerns about the project in Havana.

A database using the DHIS has been implemented within the complete hospital system, Movimiento Hospitalario (MH). This system was originally developed in Havana, and this centralized approach is in contrast to the HISP philosophy. This approach was taken due to the difficulties in travelling to each municipal and provincial office in the pilot areas. This made it impossible to implement a database based on the strong participation of local staff. This was an opportunity for both the Norwegian researchers and the Cubans to cooperate and implement the DHIS in some offices for use.

The MH consists of all elements for hospitals, which are reported quarterly from each province office to Havana in a FoxPro database. However, this database offers limited opportunities for easy manipulation and analysis in comparison to the DHIS. The goals of HISP and the Cuban Ministry of Health are not different, but the HISP approach argued for was not possible or suitable in the Cuban political, economical and cultural setting. The centralised approach of implementing systems from the top-down has to be taken into consideration when planning development approaches in Cuba.

The experience in Cuba also shows that the participatory design needs to be undertaken with some scepticism. In Cuba, people are used to agreeing with people in positions of power and are not used to opposing official views. Within this type of culture, a participatory approach is difficult to undertake. Rohitratana [14] and Walsham [15] discuss a project in Thailand, where system users did not want to confront the leadership and say that the system was not appropriate in their company because they felt that to do so was too risky. While the cultural context of Thailand and Cuba is very different, the Thailand example represents a similar case where a respect for the hierarchy and fear of losing one's position is an impediment to a participatory approach. Local managers are afraid of confronting their bosses, which in turn are afraid of confronting the next level. These types of circumstances do not make a participatory approach entirely impossible. They do however necessitate that the approach is undertaken in a diplomatic manner with actors at all levels of the hierarchy, especially those at the top. In the Cuban case, the political context was a very important issue and it was necessary to keep it in mind during all discussions and meetings in order to insure a diplomatic approach in the implementation of the HISP.

The primary goal of the HISP is to offer a decentralized health information system. This is also the goal of the new Minister of Health. He wants to change the focus from the collection of data to the use of data for the targeting of preventative health care. There seems to be a common vision, but a primary impediment is the desire to keep things centralized in Havana. From the perspective of the HISP project, the best way to achieve these goals is through the strong participation of local medical, statistical, and administrative staff. The conclusion of this paper is that an HIS project in Cuba must combine the Cuban tradition of spreading finished systems from Havana with the development methods advocated by the HISP network. In practice, this means a top-down approach in implementations combined with a design approach that combines input from all levels within the health system hierarchy. The project experience in Cuba reaffirmed the belief that there is often knowledge and understanding at the local level that does not exist at the national level. Especially in light of the highly centralized Cuban system it is of the utmost importance to find an approach that allows HISP to be viable without eliminating local participation in the design process.

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Appendix F: CD with the software tool and the Cuban databases

Attached is a cd with the software tool DHIS and the datafiles containg the Cuban databases.