The Interplay between Transformation in Everyday Work Practices and IS Design and Implementation Processes

Empirical Experiences From the Health Information Systems in Tanzania

By

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I dedicate this thesis to Hellen Mukama, Sinan Bais and Teddy Igira as an expression of my heartfelt admiration, love and appreciation for everything they sacrificed to facilitate my academic endeavours.
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# Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AfDB</td>
<td>African Development Bank</td>
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<tr>
<td>ANT</td>
<td>Actor Network Theory</td>
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<td>CBD</td>
<td>Community Based Distributors</td>
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<td>CHAT</td>
<td>Cultural Historical Activity Theory</td>
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<td>CHMT</td>
<td>Council Health Management Team</td>
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<td>CSCW</td>
<td>Computer Supported Cooperative Work</td>
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<tr>
<td>DANIDA</td>
<td>Danish International Development Agency</td>
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<tr>
<td>DHIS</td>
<td>District Health Information Software</td>
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<td>DHMT</td>
<td>District Health Management Team</td>
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<tr>
<td>DIO</td>
<td>District Information Officer</td>
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<td>DPF</td>
<td>District Processing File</td>
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<td>DWR</td>
<td>Developmental Work Research</td>
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<td>EPI</td>
<td>Expanded Program on Immunization</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<td>HCI</td>
<td>Human Computer Interaction</td>
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<td>HIS</td>
<td>Health Information System</td>
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<td>HISP</td>
<td>Health Information Systems Programme</td>
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<tr>
<td>HIV/AIDS</td>
<td>Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome</td>
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<td>HSR</td>
<td>Health Sector Reforms</td>
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<tr>
<td>ICT</td>
<td>Information and Communication Technologies</td>
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<tr>
<td>II</td>
<td>Information Infrastructure</td>
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<tr>
<td>IS</td>
<td>Information System</td>
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<tr>
<td>IT</td>
<td>Information Technology</td>
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<td>MCH</td>
<td>Mother and Child Health</td>
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<td>MDGs</td>
<td>Millennium Development Goals</td>
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<tr>
<td>MoEVT</td>
<td>Ministry of Education and Vocational Training</td>
</tr>
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<td>MoH</td>
<td>Ministry of Health</td>
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<tr>
<td>MoHSW</td>
<td>Ministry of Health and Social Welfare</td>
</tr>
<tr>
<td>MTUHA</td>
<td>Mfumo wa Taarifa za Uendeshaji wa Huduma za Afya</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organisation</td>
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<tr>
<td>NORAD</td>
<td>Norwegian International Agency for Development</td>
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<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
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<tr>
<td>PD</td>
<td>Participatory Design</td>
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<tr>
<td>PHC</td>
<td>Primary Health Care</td>
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<tr>
<td>PHCC</td>
<td>Primary Health Care Centre</td>
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<td>PHCU</td>
<td>Primary Health Care Unit</td>
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<tr>
<td>SUZA</td>
<td>State University of Zanzibar</td>
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<tr>
<td>TB</td>
<td>Tuberculosis</td>
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<tr>
<td>TBA</td>
<td>Traditional Birth Attendants</td>
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<tr>
<td>UNDP</td>
<td>United Nations Development Programme</td>
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<tr>
<td>VHW</td>
<td>Village Health Workers</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>ZHMT</td>
<td>Zonal Health Management Team</td>
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<tr>
<td>ZHMIS</td>
<td>Zanzibar Health Management Information System</td>
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<tr>
<td>ZPD</td>
<td>Zone of Proximal Development</td>
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<tr>
<td>ZPRP</td>
<td>Zanzibar Poverty Reduction Plan</td>
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Abstract

Studies recognizing that practices always contain an element of transformation are limited, not even in the integration of work practices and systems design. To address this shortcoming this thesis focuses on exploring the interplay between transformation in everyday work practices and information systems (IS) design and implementation processes. It is an interpretive and critical study initially informed by perspectives from Cultural Historical Activity Theory (CHAT) and Developmental Work Research (DWR). It builds on four papers based on a study in two health care organizations in Tanzania Mainland and Zanzibar during the period of January 2005-January 2007. It involves a study of everyday health workers’ work practices as well as the health information systems (HIS) developmental trajectory under the Health Information Systems Programme (HISP)’s initiatives. The study is an analysis of transformation in work practices that occur without and due to the effects from the IS design and implementation process, and how they impact each other. The aim is to contribute to a firmer and broader understanding of IS design and implementation processes within health care organizations and how to improve these processes.

The thesis focuses on two main questions: (1) What are the tensions that characterize transformation in everyday work practices of health workers and how do these tensions influence the design and implementation of IS?, and (2) What were the significant influence on transformation of work practices during the IS design and implementation process?

Data collection was qualitative based on ethnographic methods: a combination of formal semi-structured interviews, informal interviews and discussions (during workshops and trainings), participant observation (during formal and informal interviews, workshops and trainings), and documents analysis. Data analysis was interpretive basing on my capacity to conceptualize the gathered data in relation to the research objectives and questions. Data collection and analysis were intertwined such that analysis occurred as the data was collected leading to further data collection and analysis. I initially used theoretical perspectives from CHAT as my primary analytical tool through which themes were created. However, the data collection and analysis involved openness and sensitivity to data and unexpected elements that became known as the study progressed. In this regard, I used additional theoretical perspectives from situated action, the temporal theory of agency and information infrastructure studies to complement my analysis of the empirical data in a CHAT sense.

The findings of the study are discussed into four main aspects: (1) tensions and transformation in work practices, (2) the interplay between technology materiality, context and the temporal view of human agency, (3) participation and how to participate in the IS design and implementation processes, and (4) improving HIS design and implementation processes.

The thesis draws both theoretical and practical contribution to the IS field in general and the HIS design and implementation processes in particular. The basis for the theoretical contribution is a diversity of the theoretical perspectives and their combination in analysing the empirical material. In this regard, the thesis contributes to existing activity theoretical approaches to the study of work practices in IS research by emphasizing the following: (1) situatedness of work practices as a way to understand the tensions between the needs of an individual as part of different collective activity systems, (2) considering the practical contingencies affecting action in the present, and (3) conceptualization of aspects of work practices that are taken from one activity system to another during its expansive development. Practical contributions include: (1) studying current work practices with change thinking, and (2) contextualization of participatory design approaches in non western countries. While the practical contributions are more relevant for health care settings, which are characterized by dynamics in work practices, I do see the potential of their applicability also in other settings where work practices in based on commonly shared routines and procedures involving practices that are not easily made visible.
Appended Papers

This dissertation consists of seven introductory chapters and four appended papers as listed below.

**Paper I**


**Paper II**


**Paper III**


**Paper IV**


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CHAPTER 1: Introduction

This chapter orients the reader to the overall issues addressed in this thesis. Through the course of the chapter, the scope of the thesis is elaborated. The chapter is organized into three main sections. The first section describes the research problem areas and motivation. This description leads to the presentation of the research aim and questions in section two. The chapter ends by providing an outline on the structure of the thesis in the third section.

1.1. Research Problem Areas and Motivation

This thesis is based on my research on the design, implementation and use of Health Information Systems (HIS) within two health care organizations in Tanzania: Mainland and Zanzibar. The motivation of my research started with my masters thesis, which focused on understanding routine health care information systems at local levels (health facility and district) in Tanzania Mainland and Mozambique. It is rooted in an interest for the relationship between work practices and information systems (IS) design and implementation, combined with emerging trends in IS implementation within the health care organizations. Based on my research interest I describe the problem areas in the following subsections.

1.1.1. Work Practices and Information Systems Design

There is an increasing recognition that an understanding of current work practices is useful in the design of new information technologies (IT) and IS (Blomberg et al., 1996; Karasti, 2001). Studies of work practices have provided insights into how work is actually accomplished and how to design new technologies so that they reflect existing work practices (Berg, 1999). The focus in these studies has varied with respect to the range of activities and situations studied, the types of analyses undertaken, and the degree to which technology design is central to the research. Yet, it can be said that these studies share a commitment to describe the details of existing work: they tell us which actor performs a certain work task, in which order the tasks are performed and
with which tools and artefacts, who controls the outcome and the process, and who uses the information produced.

While studies on work practices are commonly concerned with exploring routinized work practices for the purpose of future technology design and implementation, this study puts forward a broader insight by studying transformation in everyday work practices. It recognizes that work practices always contain an element of transformation, something that is limited in previous studies on work practices (Karasti, 2001). My conceptualization of work practices is similar to Karasti’s concept of “appreciating everyday work practice in design”, which “comprises the mundane aspects of complex socially organised activities in everyday settings, both the smoothly organised routine ways of working and accustomed procedures that have evolved during years as well as the problematic situations as they rise and become handled by practitioners as part and parcel of the everyday practice (2001, p. 130).

In addition, Dybbroe (2006) argues that, contemporary researches on transformation of work are still predominantly focused on institutional and organizational analysis. In these studies, subjective and inter-subjective positions of workers are often concerned with workers expectations and opinions, and much less on workers experiences and sensing of work. With an emphasis on workers experiences and sensing of work, in this research I studied transformation of work as an individual, subjective experience without losing sight of its collective dimension. This means that, I studied individual workers who work under the conditions of societal, organizational and technological changes and conflicts. Very often, but not only, such changes and conflicts include situations as technological shifts, new forms of work organization and management, specific types of pressure from contextual problems etc. In this regard, the subjective and inter-subjective meaning of these conditions and their impacts in the context of individuals’ work experience and work prospects explored how, where and why certain activities are performed and the effects of these activities.

I relate my research to practice based approaches, which emphasize the social and post-social interaction, collective negotiation, and the collective construction of the legitimacy of the practice itself within a specific organizational setting (e.g. Nicolini et al., 2003; Nicolini, 2006; Strati, 2007). These approaches argue that knowing and doing
in an organization is contextual and materially embedded. Tools and other material aspects of ‘doing’ are central to organizational actors, to activity and knowledge. In particular, Cultural Historical Activity Theory (CHAT) and Developmental Work Research (DWR) with its emphasis on contradictions or tensions as driving forces for development and change in human work activity (Engeström, 1987; Kuutti, 1991; Engeström, 2000) played a major role in my conceptualization of work practices and their transformation (see details in Chapter 3 and 4). In this regard, I see transformation as attempts to re-conceptualise, reorganize, or remediate the work practices in order to resolve its pressing contradictions.

I see individual activities that make up a work practice as more than performing certain work task, in certain order, with certain tools and artefacts, under someone’s control. People perform their work in collaboration with each other, using tools and artefacts, creating and recreating tools and artefacts and conditions for using these tools and artefacts. During the process they are influencing and being influenced by the context they are in (Sierhuis, 2001; Sierhuis et al., 2007). I believe this view of work practices illuminates transformation in work practices as well as what makes people transform how they work in their everyday activities, including the different tools and processes that might eventually be required.

Furthermore, transformation is not seen as something taking place in the future disconnected from the present actuality, but rather as something that intertwines with incidences in the existing ways of working. It involves everyday reorganization or remediation of existing work practices in order to resolve its pressing contradictions (Engeström, 1999b), for example, the design of new tools and artefacts, or introduction of new processes and models to particular work practices. More important, this thesis emphasizes the collective and systemic character of transformation. For example, in creating tools and artefacts to meet their specific needs and conditions, individuals do also become skilful in how to work with a tool; what tasks can be accomplished with the tool, and which methods should be applied to accomplish these tasks effectively.
1.1.2. Why Studying Health Care Organizations

The health care sector presents a rich area for exploration in terms of IS design and implementation processes. Key issues for exploration such as organizational culture and work practices are central to these processes. The health care organization is characterized by the existence of heterogeneous and often opposed health care and managerial sub-cultures, and can be a challenging environment for those involved in the design and implementation of IS. The extant IS literature shows that the implementation of IS in health care has been a slow and highly problematic process in comparison with other governmental branches and industries in both developing and developed countries (e.g. Berg et al., 2003; Heeks, 2006). In this regard, the health care organization presents a rich area for studying how and why transformation of work practices occurs.

The articulated challenges on IS design and implementation within health care organizations are more prominent in low-income countries due to poor resources and lack of skills in IT (Moahi, 1999; Alvarez, 2004; Kimaro and Nhampossa, 2005). Furthermore, in these countries most health care services are provided through funding from donor agencies, who fund specific projects or programmes. One of the results of this funding focus is multiplicity of systems for health care data collection and reporting; each system focusing on monitoring a specific disease (e.g. malaria) or health problem (e.g. maternal and child health) (Chilundo, 2004). Consequently, the HIS in these organizations are complex systems because they tend to be deeply embedded in social work practices characterized by heterogeneity, fragmentation and associated problems (Braa et al., 1999; Braa et al., 2004; Sauerborn and Lippeveld, 2000). Heterogeneity and fragmentation of HIS are obviously unintended consequences of donor-funded programmes in health care organizations in low-income countries, yet quite evident.

In Tanzania, like in many other low-income countries, efforts are underway to strengthen the HIS on the basis of which to implement strategies for poverty reduction and monitor the achievement of the Millennium Development Goals (MDGs). These HIS development and implementation initiatives are taking place within a global research and development project known as the Health Information Systems Programme (HISP),
among others. The HISP initiatives seek to strengthen and further developing HIS in public health in an expanding network of low-income countries. Specifically, HISP seeks to address the problems of fragmentation and multiple data standards and implementing computerized database to assist in data storage, analysis and dissemination. The project is mainly coordinated by the University of Oslo, Norway in collaboration with local Universities and Ministries of Health in each country where it operates (see details in Chapter 2). Examples of studies articulating the challenges in IS implementation within health care organizations that have been conducted within the HISP initiatives include that of Chilundo (2004), Mosse (2005), Kimaro (2006), Nhampossa (2006), and Mavimbe (2008).

1.1.3. Selection and Gaining Access to the Research Sites

My research took place within the context of HISP initiatives during the period from January 2005 to January 2007. I am based in Tanzania Mainland, and a member of the HISP team (in both Mainland and Zanzibar). One of the initial motivations for conducting a research in Tanzania Mainland was my prior experience with the existing health care work practices surrounding the HIS. This experience was gained during my masters research within the health care sector in 2002. The study helped to initiate HISP’s activities (see the details on HISP Mainland in Chapter 2). Based on the findings and HISP’s initiatives I was motivated to expand my research from existing practices to transformation in practices. In this regard, my prior familiarity with and insights into the health care organisation and the rapport with health workers that I built during my masters research was felt to be an advantage in the sense that gaining access to the field during this research did not delay the data collection process.

While continuing with the research in the Mainland, HISP initiated its activities within the health care sector in Zanzibar. Being a member of the HISP I initially got acquainted with the work practices surrounding the HIS in Zanzibar through discussions (in HISP meetings as well as informal talks with other HISP members) and reading one of my colleagues’ work (see Sheikh, 2005). Based on these observations I was motivated by the differences in the status of existed HIS (before HISP’s initiatives) between Mainland and Zanzibar and what would be the impact in the design and implementation of new HIS (through HISP’s initiatives). While the health care sector in the Mainland had an
established formal national system of data collection and reporting, the national system of data collection and reporting within the health care sector in Zanzibar was not in place. Access in Zanzibar was therefore gained through working as the designer and implementer under the HISP project. However, for the purpose of conducting research oriented data collection methods such as interviews my role as a researcher was explained to the Ministry of Health in the beginning of my work and to health workers at various levels mainly during the introduction to the interview sessions.

In order to draw valid and generalizable conclusions, it was necessary to ensure that the organizations selected for the study would be as similar as possible. The similarity between organizations selected resides in functionality, structure and resources availability. Also important in selecting these organizations were my existing knowledge and familiarity with the culture as well as my ability to access information via the dominant language (Kiswahili).

With this background and motivation, in the next section I provide the research aim and questions addressed in this thesis.

**1.2. Research Aim and Questions**

Rooted in both theoretical and practical concerns on IS design and implementation processes within health care organizations in general and in low-income countries in particular, I argue in this thesis for the need to understand transformation in work practices; how and why work practices has developed into what is now, and what new developments already exist in its present state that anticipate and can facilitate its future development. In this regard, the research reported in this thesis is expected to contribute not only to the ongoing HISP efforts in Tanzania, but also more broadly to the research and practice of HIS in low-income countries. The research aims at:

*Exploring the interplay between transformation in everyday work practices and IS design and implementation processes,*

and thereby:

*Increase sensitivity towards context sensitive IS design and implementation.*
The quest to achieve the research aim is addressed in two interlinked research questions (RQ).

**RQ1:** What are the tensions that characterize transformation in everyday work practices of health workers and how do these tensions influence the design and implementation of IS?

**RQ2:** What were the significant influence on transformation of work practices during the IS design and implementation process?

The first research question (RQ1) is concerned with tracing transformation of work practices that occurs without the expertise of established organizations operating in the technological field under consideration, such as IS design and implementation projects and research institutes. It explores why and by what means people transform their work practices. Kuuti (1989) argues that there is no an IS without a hosting work activity. Thus, it could be useful to study transformation in everyday work practices, since one might then also gain a better insight into the development of IS. In this regard, this question helps designers and implementers of IS to focus on the needs in the work activity and why IS can assist in this respect.

RQ2 is concerned with transformation that occurs with the help of the expertise of established organizations (such as the HISP in this research). With the purpose of exploring how work practices get transformed during the IS design and implementation process, this research question addresses collaborative efforts in solving contradictions within the existing work practices and between the existing work practices and the new (being implemented) practices. It also addresses the transformation of work that is initiated without the expertise of an established organization but continues with collaborative efforts between the initiator organization and a research and development programme. The question examines the design process not as simply the development of a tool but as the development of a system to support and transform work practices in an organization. The empirical findings on these issues (for both RQ1 and RQ2) are elaborated and analysed by utilizing insights from CHAT with additional theoretical perspectives from situated action, the temporal view of human agency and studies on information infrastructure.
1.3. Structure of the Thesis

This thesis is divided into seven interlinked chapters. The chapters to come address the ideas presented in the thesis in a way that aims to demonstrate the process in which I achieved the aim of the research as well as presenting the unfolding arguments.

Chapter 2 is a description of the research setting and context. This description provides a brief history of the health care system and an overview of the HIS design and implementation initiatives within the two health care organizations in Tanzania. These are further examined in chapter 4 through a wider process of the fieldwork research, and in chapter 5 using the empirical findings.

Chapter 3 presents a review of literature on related studies on work practices within the design field and theoretical perspectives that influenced the data collection and analysis in this thesis. In this chapter, the conceptual framework that forms the analytic lens for the analysis of the empirical findings is described.

Chapter 4 describes the methodological approach adopted for the research. The chapter situate my study by reviewing the ontological and philosophical assumptions within the IS research field and describe the methods used to collect the empirical data.

Chapter 5 presents the empirical findings, which draw on the four papers appended in this thesis.

Chapter 6 discusses the empirical findings in relation to the conceptual framework presented in chapter 3. The chapter addressed how these findings contribute in achieving the aim of the research.

Finally, chapter 7 presents concluding remarks from the research reported in this thesis. The chapter summarizes the research, presents and discusses the theoretical and empirical contributions of this thesis to IS research and practice, presents limitations of the research and addresses future research.
CHAPTER 2: Research Setting and Context

This chapter describes the situational analysis of the research setting aiming at providing an overview of the context where the research was conducted. The chapter is organised into four sections. The first section describes the country's historical and contextual background: the geography and demography of the country, socio-economic profile, the education system, innovations in Information and Communication Technologies (ICTs), and the health sector and health problems. In the second section, the health care delivery and Health Information Systems (HIS) structure are described. The third section describes the HISP's initiatives and the achievements to date. This description is not exhaustive but it aims at providing an overview of issues that are related to the HIS initiatives and the health care sector in Tanzania in general. Lastly, section four provides a summary of the chapter by highlighting key issues relevant for this study as well as specific places in which the study was conducted.

2.1. Historical Background

2.1.1. Historical and Political Constituents

Tanzania, officially known as the United Republic of Tanzania (Jamhuri ya Muungano wa Tanzania in Kiswahili), is a country on the east coast of Africa. The country is named after Tanganyika, its Mainland part, and the Zanzibar islands located on its east cost. Both parts of the country have experienced long periods of colonial domination and rule. Tanganyika became independent in 1961 and Zanzibar became independent in 1963. In 1964, Tanganyika united with Zanzibar, forming the United Republic of Tanganyika and Zanzibar, which was later renamed as the United Republic of Tanzania. Zanzibar itself consists of two Islands: Unguja and Pemba. The capital city and legislative centre is Dodoma. Dar es Salaam, which is mostly known, is the executive capital and largest city in the country. In the subsequent sections of this chapter, the terms Tanzania and United Republic of Tanzania will be used interchangeably; otherwise the terms Mainland and Zanzibar will be used in specific references to either of them.
The union government recognizes two organs vested with executive powers: the government of the United Republic of Tanzania and The Revolutionary Government of Zanzibar. In this regard, the organs and functions that fall under the jurisdiction of the Union are defined. All other organs and functions not involving the union-designated matters are administered by the individual entities without approval of the union government. The health care sector and its functions is one of the domestic affairs administered separately from the Union government, but there are considerable collaborations between the Mainland and Zanzibar. Consequently, in the United Republic of Tanzania there are two autonomous Ministries of Health (MoH), each headed by a Minister, one for the Mainland and the other for Zanzibar.

### 2.1.2. Geography and Demographics

The United Republic of Tanzania is the largest of the East African countries (i.e. Kenya, Uganda and Tanzania) with an area of approximately 945,000 square kilometres: approximately 881,000 squared kilometres on the Mainland, 2,000 squared kilometres on Zanzibar, and inland waters occupy 62,000 square kilometres. Tanzania has borders to the following countries: Kenya and Uganda to the north; Rwanda, Burundi and Democratic Republic of Congo to the west; Zambia, Malawi and Mozambique to the south. On the east it has a long coast covered by the Indian Ocean (see Figure. 2.1). The country includes a number of offshore islands in the Indian Ocean.

Tanzania is administratively divided into 26 regions: 21 on the Mainland and five on Zanzibar (three on Unguja and two on Pemba). Each region has many districts, which make up a total of 131 administrative districts; the Mainland has 121 and Zanzibar has 10 administrative districts (six in Unguja and four in Pemba). Districts are further divided into divisions, which are further divided into wards. While in the Mainland wards are administratively divided into villages, in Zanzibar wards are divided into Shehias.
The United Republic of Tanzania has a population of about 34.57 million people (2002 census) with about 33 million people on the Mainland and 1 million people on Zanzibar. Population distribution is predominantly rural: about 80% in the Mainland, while Zanzibar is less rural (about 60%). However, the urban population has been growing at a rapid rate of more than 5 per cent per annum over the past three decades. This rapid growth has been caused mainly by rural-urban migration than any other factor. The average population growth rates are 2.8% for Mainland and 3.0% in Zanzibar, whereby the regions that show high rates of growth are dominated by large urban areas\(^2\). In this regard, the population was estimated to be about 38 million people in the year 2007. The life expectancy at birth is 45.9 years (UNDP, 2006).

\(^2\) [http://www.tanzania.go.tz/census/reports.htm](http://www.tanzania.go.tz/census/reports.htm)
2.1.3. Socio-economic Context

The Tanzanian population consists of more than 120 ethnic groups whereby each group has its own first language. After independence the government of Tanzania realised that tribalism would be one of the obstacles to create national unity and therefore promoted Kiswahili as a common language (Khamisi, 1991; Mbaabu, 1991). In this regard, it is suffice to say that the rise and spread of Kiswahili from a community language to a national language, was largely demand driven in the socio-economic sense. Thus, Kiswahili became the official national language, used for intertribal communication and for official matters. Most rural people in Tanzania use their first language (from their ethnic group) for most activities, but use Kiswahili with people from other ethnic groups. It is also common for people of numerous ethnic groups besides Kiswahili who grow up in certain towns to speak Kiswahili as their first language. Kiswahili language is basically of Bantu (African) origin (for the origin and rise of Kiswahili see for example, Mbaabu, 1991; Mukuthuria, 2006). It has borrowed words from other languages such as Arabic, Persian and Portuguese. In addition, English, the language of colonial administration during the era of British rule, continued to be used for some official issues after independence, and is thus considered as official alongside Kiswahili.

Tanzania like many African countries has experienced considerable strife since independence, and its economy is extremely weak. With an estimated per capital income of USD 340 a year, Tanzania is one of the poorest countries in the world, ranking 162 out of 177 countries on the UNDP Human Development Index (UNDP, 2006). Traditionally, agriculture has been the backbone of Tanzania's economy. 80% of the population find employment in the sector generating 60% of the country's gross domestic product (GDP). However, the agricultural sector is characterized by low productivity, low levels of technology and mainly subsistence farming, which depends on topography and climate conditions. In addition, Tanzania has vast amounts of natural resources including gold deposits and beautiful national parks. However, more efforts are required to fully develop the potential of these resources. With funds from international organizations such as the World Bank, the International Monetary Fund, and bilateral donors, efforts are underway to rehabilitate Tanzania's deteriorated economy infrastructure. Furthermore, recent public sector and banking reforms, and
new legislative frameworks have all helped to increase private sector growth and investment.

The Tanzania transport system comprises the road network, rail systems, seaports and three international airports plus several major domestic ones. The road sector is by far the dominant mode of transport representing 70 per cent of freight and 90 per cent of passengers in the country. However, Tanzania’s road network is considered poor by international standards, with the situation being particularly serious in rural areas and better for trunk and regional roads (AfDB/OECD, 2007). More efforts are underway in improving these roads, starting with the trunk and regional road network (Daima Associates Limited, 2007).

2.1.4. Educational System

The United Republic of Tanzania realizes that quality education is the pillar of national development, for it is through education that the nation obtains skilled human resources to serve in various sectors in the nation’s economy. The structure of the formal education and training system in Tanzania constitutes three main levels:

- Basic: 2 years of pre-primary education, 7 years of primary education, and non-formal adult education.
- Secondary: 4 years of junior secondary (ordinary level), 2 years of senior secondary (advanced level)
- Tertiary: 3 or more years of education (programmes and courses) offered by non-higher and higher education institutions.

The Tanzania’s educational system uses the bilingual policy, in which both Kiswahili and English are used. While Kiswahili is a medium of instruction in primary schools, all secondary schools and universities use English as the medium of instruction. Furthermore, the growth of the private sector and new investments has resulted in English having increasing importance, and there are a number of primary schools in which English is the medium of instruction. English is essential, as it is the language which links Tanzania with the rest of the world through technology, commerce and other economic activities. The learning of Kiswahili enables Tanzanian students to keep

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3 [http://www.tanzania.go.tz/educationf.html](http://www.tanzania.go.tz/educationf.html)
in touch with their cultural values and heritage. However, since Kiswahili is mostly used in homes and in public communication activities, the majority of the population is more fluent in both spoken and written Kiswahili as compared to English.

In parallel with the formal education systems, students do get public health education. Public health education is mainly concerned with identifying prevailing health problems and disseminating to the public methods of preventing and controlling them. This is an integral part of community involvement in Primary Health Care (PHC). It is assumed that, the health of an individual, the family and community at large is dependent upon factors as environment, sociocultural traditions and life styles, hence public health education focuses on strengthening and addressing issues related to agricultural development, child up-bringing, environmental sanitation and development in general. For instance, primary school children are special target group for health education through the school health programme. In addition, public health education is provided by a variety of methods including mass media, continuous development and dissemination of health education materials such as posters and through dialogue with communities.

2.1.5. Innovations in Information and Communication Technologies

The use of information and communication technologies (ICTs) is growing rapidly in most low-income countries and Tanzania is no exception. For the last ten years, Tanzania's central and local organizations have promoted the use of ICTs as a factor, which can accelerate the socio-economic development of the country. The term, “ICTs”, refer to everything from radios to telephones, from fax machines to computers, and from electronic mail (email) to the World Wide Web (WWW). Among the initiatives taken to promote ICTs was the development of a policy document that addresses the ICTs sector as a whole (Ministry of Communications and Transport Tanzania, 2003). This policy makes it possible for enabling sectors (such as telecommunications, information, or broadcasting) to work together whereby enabled sectors (such as education, health, governance, or agriculture) can become further empowered through the appropriate development and application of ICTs (MoEVT, 2007).
The private sector has actively contributed to these achievements by investing in among others, support facilities, training centres and sales outlets. These efforts have enabled government departments, institutions of learning, Non-Governmental Organisations (NGOs), as well as other entrepreneurs to acquire ICTs solutions that address their individual problems. New computer related schools are increasing. Internet cafés are also becoming more prevalent; almost one per square block in towns and larger cities like Dar es Salaam and they are affordable for the average Tanzanian.

However, despite the rapid improvements, Tanzania's ICTs environment is still somewhat challenged. ICTs are concentrated in Dar es Salaam, the commercial capital with little deployment or access in other urban centres and rural areas (Isamuyo, 2006). Most of the Tanzanian population remains isolated from telecommunications and information technology and face many barriers (such as limited electric power) before reaping the benefits of new technologies. Currently, very few educational institutions are equipped with sufficient computer laboratories and other multimedia facilities and these are more prevalent in private educational institutions than in public ones. In this regard, facilities are insufficient to meet the demands of not only ICTs use, but also education. Most of the hardware and software used by both public and private sectors is imported at considerable costs. However, there are no standards guiding the imports of both hardware and software. In general, Tanzania has a small emerging skilled capacity to support the ICTs industry in terms of developing or supporting hardware and software (Ministry-of-Communications-and-Transport-Tanzania, 2003).

The ICTs situation in Tanzania might seem too far behind to ever bring itself fully into the modern technological-age, but Tanzania does have the unique opportunity of being able to leapfrog technologies. There are currently a number of ICTs development initiatives funded by different international organizations and countries. These projects range from telecentres in rural areas (e.g. Mercer, 2005) to e-Government initiatives being implemented in the heart of Dar es Salaam (e.g. Kaaya, 2004). Moreover, recent developments in wireless local area network technologies have facilitated an increase in the number mobile phone users. This may as well raise new hopes for internet diffusion in most parts of the country (POST, 2006).
2.1.6. The Health Sector: Historical Context and Reforms

During colonial administration, health services delivery in Tanzania was largely a prerogative of the state, only a limited number of private-for-profit health services were provided in major towns of the country. After independence, health care facilities were re-directed towards rural areas (Kopoka, 2000). Plans for the establishment of health facilities have in the past taken into consideration the facility/population ratio, but with time this has in some areas been seriously overtaken by the high population growth-rate.

The Ministries of Health appraised the health sector performance with the intention of raising strategies to improve quality of health services and increase equity in health accessibility and utilization. This appraisal came up as a step towards the Health Sector Reforms (HSR) in 1993 in the Mainland and 1994 in Zanzibar. The reforms are in the following dimensions: managerial reforms or decentralization of health services; financial reforms, such as enhancement of user-charges in government hospitals, introduction of health insurance and community health funds and public/private mix reforms such as encouragement of private sector to complement public health services. They also include organisational reforms such as integration of vertical health programmes into the general health services; health research reforms such as establishment of a health research user funds and propagation of demand oriented researches in the health sector. In this regard, the health sector is one of the largest beneficiaries of development co-operation in the public sector in Tanzania (Mapunda, 2003).

Decentralization has strengthened capacity at the district level to manage health services. Participatory structures have been created through the development of the basic health care package concept and the common basket system which allocate more health care resources at the district level. While the management responsibilities of the health care system have been decentralized to the regions (zones in Zanzibar) and more prominently to the districts, overall financial decision-making and budgeting decisions continue to be made at the national level in the Ministry of Finance and Ministry of Health. Moreover, studies have indicated that decentralization efforts in low-income countries in general and Tanzania in particular have not been effective (e.g.}
Mwangu, 2003; Kimaro, 2006). This is partly due to the socio-economic environment: poverty, growing impact of epidemic diseases and increased burden of care on the public sector, which is not conducive for achieving a significant success in people's health status, and partly due to the lack of reliable information for decision making.

Geographical coverage of health care facilities is equitable, providing access to more than 80% of the population, but quality of care is generally low. Health workers are unequally distributed, especially in Zanzibar and in rural health facilities in the Mainland. This is due to lack of incentives to attract and retain health professionals in underserved remote areas. Drugs and medical supplies are inadequate at all levels of health care delivery. Sustainability is scarce and the country still depends on foreign and donor assistance to fund essential drugs and supplies. In addition, transport availability for district health care activities depends mostly on donor support, hindering the referral system, health facilities supervision and implementation of health care programmes. In this regard, in both the Mainland and Zanzibar, the reforms have not fully responded to the needs of the population, especially for the poor households and rural communities (WHO, 2002).

Most of the disease burden in Tanzania is the result of preventable diseases: communicable diseases such as HIV/AIDS, Malaria and Tuberculosis (TB); reproductive disorders; child disorders – over 75% of under-five deaths are attributable to pneumonia, diarrhoea, measles and malnutrition; non-communicable diseases such as diabetes, hypertension and cardiovascular diseases. However, disease wise, malaria is the major cause of morbidity and mortality for children under five in both the Mainland and Zanzibar. Nationwide, malaria accounts for 30% of total disease burden. The UNDP Report for 2007/2008\(^4\) estimate infant and under-five mortality rates at 200 per 1,000 live births nationwide. Furthermore, despite major efforts made, access to quality reproductive health services remains a problem area as reflected in the high maternal mortality rate of 2,000 per 100,000 live births.

\(^4\)http://hdrstats.undp.org/countries/data_sheets/cty_ds_TZA.html
2.2. Health Care Delivery System

Health care services in Tanzania are currently being provided by the government, parastatal organizations, voluntary organizations, religious organizations, private practitioners and traditional healers. With traditional healers in the community health care services in both the Mainland and Zanzibar starts at the family level. Like in many low-income countries, the provision of health care services in Tanzania is also funded by international donor agencies who often give foreign aid towards particular projects or specific programmes (such as those centred on tuberculosis, reproductive health, and malaria) rather than towards the general budget administered by the government (Brown, 2001).

Taking into consideration that each entity of the United Republic of Tanzania has its own autonomous Ministry of Health, in the following sub-sections I describe the two health care delivery systems and the respective HIS separately.

2.2.1. Mainland

The Mainland’s health care delivery system was derived from the colonial urban- and curative-based health system, when it was established in 1961 upon the independence of the country. The early national health system was characterized by inadequate and scattered health infrastructure and other resources with little equity and accessibility for the population as a whole. In the late 1960’s, the post-colonial government through the Ministry of Health began to deliberately expand health services, infrastructure and other resources in the rural areas along with the implementation of various health care policies and strategies. Today, Tanzania Mainland is described as having achieved remarkable progress with regard to the distribution of health facilities throughout the country.

The current health care delivery system in the Mainland and especially the government's referral system assume a pyramidal organization structure of health services, which is from the primary level (village health posts, dispensaries, and health centres) to district hospitals, regional hospitals and finally, consultant hospitals (World
The structure of health services delivery at various levels in the country is as depicted in Figure 2.2.

**Village health services:** This is the lowest level of health care delivery in the country, staffed by village health workers who essentially provide first aid services which can be offered in homes. The village health workers are chosen by the village government amongst the villagers and are given a short training before they start providing services.

**Dispensary services:** This is the second level of health care delivery. Dispensaries provide basic curative and maternal and child health (MCH) care and general preventive health care services. They are usually headed by a clinical officer, who is supported by the MCH aide and other health workers who do not necessarily get formal training in health care delivery activities. In parallel with providing health care services, a dispensary supervises all the village health posts in its ward.

**Health centre services:** A health centre is expected to cater approximately the population of one administrative division. In addition to the basic curative and maternal and child health services being provided by the dispensaries, health centres provide inpatient and obstetric services. They are physically larger institutions than dispensaries and are served by a larger staffing complement.
**District hospitals:** The district is a very important level in the provision of health services in Tanzania. Each administrative district is supposed to have a district hospital. For those districts which do not have a government district hospital normally have religious organizations that designate voluntary hospitals.

**Regional hospitals:** In addition to services provided at the district hospitals, regional hospitals have specialists in various fields and thus offer more services which are not provided by the district hospitals. Basically each region is supposed to have a regional hospital.

**Specialized/consultant/national hospitals:** This is the highest level of health care services for both the Mainland and Zanzibar. In addition to providing health care services, the referral/consultant hospitals serve as centres for medical training in the Mainland as well as for health workers from Zanzibar.

Statistics from 2000 indicate an extensive health services infrastructure on the Mainland, composed of 280 hospitals and specialized clinics, 479 health centres and 3,955 dispensaries. The ratio of medical doctors and nurses to the population is 1:20,000 and 1:5,000 respectively.

**2.2.2. Zanzibar**

After independence the government of Zanzibar assumed total responsibility for the provision of health care services to its population through a free provision policy. A substantial health service delivery infrastructure was developed and continues to be developed, thus creating service delivery capacity, which can ensure equity of access for primary health care services. A situation which has made the majority of the population of Zanzibar be within 10 kilometres of health care services. In line with ongoing health sector reforms in Zanzibar (HSR 2004 - 2009), the health infrastructure currently comprises primary health care units (PHCUs), primary health care centres (PHCCs), district hospitals and a referral/consultant hospital. These infrastructures are categorized into three main levels: primary, secondary and tertiary (Figure. 2.3).

**Primary level:** This is the lowest level of the health care delivery structure. It includes 1st and 2nd line PHCUs (Dispensaries) and PHCCs (referred to as Cottage Hospitals).
Health facilities at this level provide basic curative and maternal and child health (MCH) care, and general preventive health care services. 1st line PHCUs are health care facilities which conduct basic curative services but cannot do laboratory tests or provide dental care services. 2nd line PHCUs are health facilities with the capability of both providing basic curative services, do laboratory tests and provide dental care services. The PHCCs provide more services than the PHCUs including minor operations, admissions and X-ray services.

**Secondary level:** These are the district hospitals that serve as referral points for the primary level health care facilities. In addition to services which are being provided by the primary level health facilities, district hospitals are capable of performing major operations and some have specialized doctors.

**Tertiary level:** At this level is where there is a specialized hospital providing a full range of specialized services for referred and emergency conditions. In addition to providing health care services, the hospital serves as a centre for medical training in Zanzibar. Currently there is one specialized hospital in Zanzibar located in Unguja Island – Mnazi Mmoja referral hospital. The hospital also provides secondary health care services for the population in Unguja Island.

![Figure 2.3: Health care delivery structure in Tanzania - Zanzibar](image)
It is also important to note that in practice the higher level health care facilities can also provide (and does in fact provide) services that are being provided by health facilities at the lower levels. In this regard, the health care facilities at the secondary level (district hospitals) can also provide primary health care and the tertiary level hospital can also provide secondary and primary health care services, basing on its closeness to the population. Zanzibar has 6 hospitals, 4 primary health care centres and 103 primary health care units with a doctor to population ratio of 1:13,115.

2.3. The Health Information System

In implementing the health sector reforms, Tanzania has been developing, implementing and using health information systems (HIS) for health care data collection, processing and reporting within and between all levels of the health care organization. The aim being to generate information necessary for improving health services effectiveness and efficiency through better management at all levels. However, like any other low-income country, Tanzania has lived with a number of shortcomings in its HIS. In this section I describe the background and work practices of existing/existed HIS.

2.3.1. Mainland

The current HIS in the Mainland dates back to 1993 where the main objective during its establishment was to optimize the performance of the health sector through the provision of guidelines and tools for collection, analysis and use of data and information at all levels within the health care delivery system. This objective came up after several evaluation studies indicating weaknesses in the HIS which existed from 1980’s. The weaknesses included inaccurate and unreliable data, fragmentation of IS (existence of many different programme specific IS), bottom-up IS with data collected at the lower level and used at the national level (Rubona, 2001; Mwangu, 2003). MTUHA is the name of the current HIS that operates in the Mainland part of Tanzania. It is an acronym for a Kiswahili name “Mfumo wa Taarifa za Uendeshaji wa Huduma za Afya.”
MTUHA is a hybrid system of both paper-based forms and a computer database. The design of a paper-based HIS was undertaken in 1989-1990 by top level officials in the Ministry of Health in collaboration with donor organizations (for example, DANIDA). One of the guiding objectives being to establish a system that is decentralized, integrated, functional, and reliable. Parallel to the design of a paper-based part of MTUHA, a computer database was developed. The implementation of the new paper-based and computer-based HIS was carried out from 1993 through 1997. MTUHA covers all primary health care programmes and services involving all public and private health facilities in the Mainland.

The operational and administrative design of MTUHA follows the structure of the four levels of the national health system, namely, health facility level, district level, regional level and the national level (Figure 2.4). Following this structure, health facilities are the origin of data within MTUHA. The district, under the Council Health Management Team (CHMT) remains as the main operational unit for implementing health programmes, for managing the primary health care facilities, and as the focal point for data collection, aggregation and information flow within the MTUHA.

The health workers in the health facilities collect data routinely and compile aggregated reports on a quarterly basis (three months reports). In addition, health facilities are responsible for collecting data from the community within their administrative ward(s) through the Village Health Workers (VHW), Traditional Birth Attendants (TBA) and Community Based Distributors (CBD) for contraceptives. Data collection is done using a set of 12 register books and tally forms for different health care programmes and services (for details on data collection and information flows see for example, Ministry of Health Tanzania, 2002; Mukama, 2003).

Reports from the health facilities are sent to the district level where they are collated and aggregated to generate a district report. When MTUHA was introduced the report preparation was done manually in all health care districts, that is, using a paper-based database called the District Processing File (DPF). In November 2005, the Ministry of Health (MoH) introduced a computer database resembling the DPF in format to be used for data processing, report preparation and reporting at the district level. However, only those districts offices with electricity use a computer database and those without electricity continue to use the DPF. Reports from the districts are sent to the regional
level, where the reports for a particular region are generated and sent to the national level. At the regional and national levels, reports are generated using a computer database. Data are stored in both paper forms and in the computer database.

Since its implementation MTUHA has undergone changes and adjustments with regard to the paper forms, software (database) being used, the items to be collected and procedures and formats for reporting. However, several reviews on both the manual and computerized parts of MTUHA have been conducted which revealed that the system has not achieved the desired objectives: producing information for decision-making at all health care levels (HERA, 2000; Rubona, 2001; Lungo, 2003; Mukama, 2003). The Health Information Systems Programme (HISP) is among the initiatives taken in the Mainland to address the shortcomings of MTUHA (see section 2.4.1).
2.3.2. Zanzibar

The health care administrative structure in Zanzibar consists of four main levels: the national level, the zonal level, the district level and the health facility level. Before 2000, the HIS in Zanzibar was mainly a diseases surveillance system in which the primary objective was to determine the burden of diseases and the rate of occurrence of new cases of diseases. The health care facilities (government) were the main source of data for this system and the system was mainly shaped by the organization of vertical programmes requirements (see Figure 2.5). In addition to data from the health facilities, other complimentary sources were used such as specific laboratories and surveys.

In 2000 the Ministry of Health and Social Welfare (MoHSW) of Zanzibar established a Zanzibar Health Management Information System (ZHMIS). For consistency purposes the terms HIS and Ministry of Health (MoH) in Zanzibar will be used to represent ZHMIS and MoHSW respectively. The HIS was established through uniting three units within the MoH in Zanzibar: Epidemiology, Statistics and Research. It was only based on paper tools for data collection, analysis and dissemination and it covered only governmental health facilities. During this time the HIS continued to be shaped by the organization of vertical programmes’ requirements. In this regard, the design of the
data collection and reporting forms and their reliability depended much on the programme requesting the data. Furthermore, additional data was supposed to come from the TBAs in the respective Shehias. However, there was lack of a proper recording system for this data.

Two reporting routines existed: monthly and quarterly. Health facilities reported to the district level only on monthly basis and the district level reported to higher levels on both monthly and quarterly basis. That is, reports from the district level were sent to the specific vertical programme’s office each month and to the MoH on quarterly basis. However, the quarterly reports from the district were mainly describing the district’s activities and general health profiles. Major reports came from a ‘stroke form’, which is a tally sheet used at the health facilities for recording outpatient cases grouped by diagnosis, age and sex. Therefore, data at the HIS unit within the MoH depended mainly on the stroke form from the health facilities.

In November 2004, the MoH in Zanzibar and its stakeholders conducted a HIS review. This review included both the HIS operating between the four health care administrative levels (health facility, district, zone, national) and the HIS within the hospitals (the cottage, district and referral hospitals). The results revealed that the fragmented HIS (Figure 2.5 and 2.6 respectively) that was in place does not support data driven decision-making for all health care stakeholders. Different health programmes had their own IS for data collection and reporting.

Figure 2.6: Fragmented structure of the information system within hospitals in Zanzibar
The main problem at the referral hospital was lack of standards in reporting from the wards and clinics and therefore no systematic overview at the hospital level of the basic indicators for management. At the district hospitals and cottage hospitals health workers collected daily inpatient and outpatient data using hand drawn register books with no system of reporting and therefore data was stored in the respective registers within the respective ward or clinic. To address these problems the Health Information Systems Programme (HISP) was contracted to work together with the MoH in Zanzibar and other stakeholders (see section 2.4.2).

2.4. HISP Initiatives and Achievements

In this section, I discuss the on-going HISP activities in the public health sector in Tanzania Mainland and Zanzibar. Originating from South Africa, HISP aims at enhancing district HIS in low-income countries through the introduction and local adaptation of open source software known as the District Health Information Software (DHIS). The DHIS is designed based on a more flexible approach, which allows integration of information from various data sources and provide flexibility to meet the rapidly changing requirements of the health care sector. The flexibility enables the user to develop different custom reports for analysis and decision making (Igira et al., 2007).

HISP is currently working in an expanding network of low-income countries including Tanzania – Mainland and Zanzibar, Mozambique, Malawi, South Africa, India, Ethiopia, Vietnam, Botswana and Nigeria. In this regard, the knowledgebase for further developing the DHIS according to local requirements is sought around the HISP network and experienced team members are moving from one country to another in the process of sharing experiences. These HIS enhancement initiatives take place within the organization culture and structures of existing HIS within the respective health sectors and countries. The general aim of HISP is to empower the districts, and the Ministry of Health in low-income countries in developing their own plans according to district priorities and requirements, reflecting national policies and guidelines, monitoring and evaluation of annual work plans. According to the now classical WHO definition, a district health system based on primary health care is a more or less self-contained segment of the national health system. It comprises first and foremost a well-
defined population living within a clearly delineated administrative and geographical area. It includes all the relevant health care activities in the area, whether governmental or otherwise (WHO, 2000).

HISP is mainly coordinated by the University of Oslo, Norway in collaboration with local Universities and Ministries of Health in each country where it operates. In Tanzania, HISP works in collaboration with the University of Dar es Salaam, Ministry of Health in both the Mainland and Zanzibar and the Danish International Development Agency (DANIDA) in Zanzibar. It uses action research and participatory design approaches which are characterized by the adaptation, localization and implementation of the open source DHIS database and training of health workers on its use.

2.4.1. HISP Mainland

HISP initiated its activities in the Mainland in July 2002 through the work of researchers from the University of Oslo and masters students from Tanzania studying in Oslo. Later on a local team composed of university based researchers and health practitioners were created, in which I am a member. The two masters students did their research in two districts of the Coastal region (Kibaha and Bagamoyo) which became pilot sites for HISP (Lungo, 2003; Mukama, 2003).

In improving the MTUHA system, HISP’s plan was to revise existed essential data sets for data collection, adjusting the reporting routines from quarterly (three months) to monthly as a way of minimizing the need to calculate and aggregate a lot of numbers at the end of each quarter, revise the register books and paper forms, customizing the DHIS to fit with the data sets being collected and implementing the DHIS at the district, regional and national levels. To date, there have been continuing discussions between the HISP team and health officials and managers at various levels regarding routine data-handling problems and how to address these problems.

Researchers from the HISP network have also been involved in these discussions. These discussions have been partly conducted through meetings and workshops and partly through organized on-site and off-site trainings and courses. For example, in 2002, initial trainings were conducted in the pilot districts, followed by intensive
trainings of health workers in 2003. These trainings were strengthened through continuous user support provided on request basis.

Further initiatives in the global HISP network have been conducted to provide skills, learning, and experiences to Ministry of Health officials and local HISP team members. Examples include: the participation of Tanzanian HISP members in DHIS courses that was conducted in Malawi and South Africa in 2002; the establishment of a one-year formal course in HIS design and implementation. This course was conducted in two consecutive periods of 2005 and 2006 in collaboration between the University of Oslo and University of Dar es Salaam (Department of Computer Science) with funding from the Norwegian International Agency for Development (NORAD). In 2007, the global HISP network advanced this one-year course into an integrated two years masters in Health Informatics. The course is conducted in Tanzania (University of Dar es Salaam and Muhimbili University College of Health Sciences) and Ethiopia (Addis Ababa University and University of Gondar). It is open for students that are qualified either by the disciplines of informatics or public health and provide elective specialization for both areas. In addition, HISP members have also conducted research individually for their masters and/or doctoral research, thereby contributing to HISP work in the Mainland, the larger HISP network, and the IS research community in low-income countries (e.g. Lungo, 2005; Mukama et al., 2005).

2.4.2. HISP Zanzibar

In December 2004, the MoH in Zanzibar and the HISP team (including those in the Mainland and others from Zanzibar) in collaboration with DANIDA, started to strengthen the HIS by developing a roadmap which defined the main objectives for addressing the weaknesses within the HIS (see also, Lungo et al., 2007; Lungo and Igira, 2008). This roadmap consisted the following: 1) development of essential indicator and data sets to cater for the needs of all stakeholders, (2) developing and implementing a computer database, and (3) developing human and institutional capacity. A workshop involving major health sector stakeholders was then conducted to discuss the developed roadmap. Participants from different vertical programmes, HIS unit, referral hospital, representatives from the Zonal Health Management Teams (ZHMTs) and District Health Management Teams (DHMTs) were involved. In this workshop a HIS
taskforce was established and three pilot districts were selected: two on Unguja Island and one on Pemba Island. The development process started in January 2005 and is described through the objectives set in the roadmap. The same roadmap was used for developing the HIS for a district based reporting system (Figure 2.5) and a hospital based reporting system (Figure 2.6). I now describe the two processes separately.

**HISP Activities on a District Based HIS in Zanzibar**

The HIS design and implementation process started with a review of all the existed data collection and reporting forms at the health facilities and district levels. The aim of this review was to identify minimum data sets which were easy to use and at the same time cater the need for important health care indicators (local and international wise). An example of the changes made was the modification of a ‘stroke form’ in which the age categories were reduced and missing diseases were added, the arrangement of diseases (structure of the form) changed whereby those diseases with high prevalence came first in the list. After the identification of essential data sets, the data collection and reporting forms were designed. The design of the forms put into consideration both the layout and size of the form aiming at making it simple for the users to fill in. The designed forms were then tested in the pilot sites where health workers used the forms for data collection and comments from the users in the pilot districts were collected.

In March 2005, a workshop involving representatives from the district level, zonal level, MoH and vertical programmes was conducted to review the developed data sets based on users’ comments. The revised forms were then taken back to the pilot districts for further testing. While the paper forms were being tested, a computer database (the DHIS) was being customized to fit the specifications in the paper forms as well as the health care data reporting requirements as a whole. The customization process was done following an incremental approach, which took place in two phases: the first phase involved registering all health facilities and their respective districts, prototyping an EPI programme data reporting form; and then the remaining forms were planned for the second phase. The form for the EPI programme was selected because the review of the data collection forms revealed a more stable state in this respective form.
In December 2005, a workshop led by the HISP team was conducted in order to: define the essential indicator sets basing on Millennium Development Goals (MDGs) and the Zanzibar Poverty Reduction Plan (ZPRP); and revise the data collection tools (both the paper forms and the DHIS) based on the defined indicators and the collected comments from the pilot districts. This workshop cleared the way for rolling up the newly designed data collection forms to be used in all health facilities throughout Zanzibar in January 2006.

The second phase of customizing the DHIS to mimic all the paper forms was done after the second review of paper forms in December 2005. More than mimicking the paper forms, the DHIS was customized such that the same data reported by more than one health facility (e.g. number of malaria cases) was standardised and made “integratable”, among other things. In this regard, the enrolment of the data collection forms throughout the country went in parallel with the installation of the DHIS in all health districts, at the MoH and in vertical programmes offices. During this time there was no internet connection and therefore the DHIS was distributed through the use of CDs and Flash disks. However, while the process was still going on, another project on connecting all health care districts with internet was initiated. A situation which led to the possibility of health care districts sending reports to the MoH through email attachments.

Since a countrywide implementation of the paper forms and the DHIS, a number of training and user support have been provided to health workers at different health care levels particularly in the health facilities and at the district level. In addition, the implementation process was done in parallel with involving eleven health workers from the HIS unit, zones and districts in an extended course in HIS at the University of Dar es Salaam, Tanzania. At the time of writing this thesis, the DHIS has already been implemented in all districts on Unguja and Pemba islands.

The HISP’s model of integrated district based HIS is presented in Figure 2.7. In this model health workers in the health facilities collect data routinely in the register books. At the end of each month the collected data in the register books is summarized in paper forms and reported to the district level. At the district level data from the paper forms is entered in the DHIS where analysis and, monthly, quarterly and yearly aggregates can be done. Data from the DHIS at the district level is sent directly to the
national level (Ministry of Health) and vertical programmes’ offices through email. At the Ministry of Health and vertical programmes’ offices, data from the districts is entered into the DHIS through its import functionality. The same data that is sent to the Ministry of Health is also sent to the zone level for decision making purposes.

![Diagram of the HISP's model of integrated district based HIS in Zanzibar](image)

Figure 2.7: HISP’s model of integrated district based HIS in Zanzibar

Furthermore, several interventions to strengthen the HIS activities have been carried on including a third revision of data collection tools (both the paper forms and the DHIS) and indicators, and the preparation of the HIS guideline - a policy document that offers full authority, directives and responsibilities to the HIS unit and all its stakeholders.

**HISP Activities for the Hospital Information Systems in Zanzibar**

The HIS design and implementation process within hospitals started in June 2005 and still ongoing. The process started with the referral hospital and then scaled down to the district and cottage hospitals. In this regard, experience and key lessons learnt from the referral hospital played a crucial role during the scaling down process (see also, Igira, 2007; Igira et al., 2007). Practicing user participation, the design process started by identifying health workers (users) from the referral hospital to work with the HISP team. The identified users included the head of the statistics department, the in-charges from different wards and clinics and one doctor who is also the assistant head of the
A meeting between the HISP team and the users’ team was then conducted to review the existed data collection tools and thus establish a standardized reporting format for the referral hospital. The results from a meeting were used to design data collection forms, which were put into use (piloting phase) for one month. Then a group discussion between the users’ team and the HISP team was conducted to review the paper forms as per users’ feedback. The review process involved adding more data sets as well as eliminating some of the data sets. After this first review of the paper forms, the DHIS was customized to include the identified data sets.

Similar to the DHIS for the district based HIS, the DHIS for the hospital was customized such that the data reported by more than one ward or clinic (e.g. number of hypertension cases) was standardised and made “integratable”. Moreover, the most important data for the hospital management to integrate was the through-put data from the wards and clinics. Each ward reports the total monthly numbers on admissions, discharges, deaths and laying days through their respective paper forms. Likewise, each clinic reports monthly head counts on female, male, under 5 years, above 5 years, and repeated clients.

As the new paper forms and the DHIS took shape and their advantages became evident at the referral hospital, the design and implementation process was replicated in the district hospitals. The tools (paper forms and the DHIS) and the processes followed at the referral hospital formed the basis for the design and implementation process in the district hospitals. However, due to specific contextual requirements, several aspects of these tools (such as some of the data sets) had to be modified to fit with the data requirements in these hospitals.

Health workers within the wards and clinics in hospitals were trained on how to fill in the new designed paper forms as well as using the DHIS. However, due to lack of computer resources as well as the division of work among the health workers at the hospital, not all health workers were trained in how to use the DHIS. Only the health workers who work at the hospital’s statistics department (responsible for compiling all reports from the wards and clinics) were trained. The DHIS training had to start with basics of using computers such as how to move a mouse since most health workers had
never used a computer. Furthermore, two health workers from the hospital were
involved in an extended course in HIS at the University Of Dar es Salaam, Tanzania
which also included practical exercises on using the DHIS. The combination of on-site
training and the HIS course had been helpful in creating a shared understanding and
general knowledge about key principles related to HIS.

At the time of writing this thesis there are standardized data collection and reporting
tools consisting of essential data sets for each ward and clinic. Reporting routines have
been established whereby health workers in the wards and clinics collect data
routinely in the register books. At the end of each month the collected data in the
register books is summarized in a paper form and reported to the statistics
department. At the statistics department data from the paper forms is entered in the
DHIS where analysis and, monthly, quarterly and yearly aggregates can be done. Data
from the statistics department is sent to the Ministry of Health and vertical
programmes through email. At these levels data from each hospital is entered in the
DHIS through its import functionality. HISP’s model of integrated HIS within hospitals
in Zanzibar is presented in Figure 2.8.

![Figure 2.8: HISP's model of an integrated information system within hospitals in Zanzibar](image)
Recent developments on working with the 2006 annual reports for both the district and hospital based HIS have shown signs of transformation. The fact that annual reports must be delivered has opened up for some time and place for the software to be used and more training sessions to be organized at the management level. Furthermore, the fact that most health workers were computer illiterate, the use of DHIS has opened possibilities and motivation for health workers to learn how to use computers. The network and internet facilities that have been established between the districts, hospitals and the Ministry of Health facilitate the data reporting, transmission and sharing process through email. An additional advantage with this network and internet is that health workers at the districts and hospitals can communicate within the hospital as well as with the Ministry of Health through Skype.

2.5. Summary: Where I have been and Key Contextual Issues

I have conducted my research in two districts of the Coast region, which are pilot sites for HISP activities in the Mainland part of Tanzania. In Zanzibar, I have been in two districts in Unguja zone and three districts in Pemba zone. More fieldwork was done in hospitals (cottage, district and the referral hospital) in Zanzibar. Parallel with conducting research activities in both settings, I have been working as a member of both the HISP Mainland and HISP Zanzibar teams in which I participated in the HIS design and implementation activities as well as teaching the HIS course at the University of Dar es Salaam.

The chapter has provided an overview of the setting and context in which this research took place. The historical background, which describes the various forms of socio-economic, cultural and political domains helps to situate the HIS design and implementation initiatives within the broader context of the health sector reforms in low-income countries and Tanzania in particular. Furthermore, the chapter provide a description of the health care delivery and the HIS, which is useful for understanding existing work practices within the health care sector in Tanzania.
CHAPTER 3: Frame of References

This chapter presents an overview of the theoretical perspectives that influenced the data collection and analysis in this thesis. My thesis is informed by perspectives from Cultural Historical Activity Theory (CHAT) and Developmental Work Research (DWR) with additional influences from participatory design approaches, situated action, the temporal view of human agency and information infrastructure studies. I have used these perspectives for finding my own position and my conceptual understanding of the empirical research. The chapter is divided into four main sections. The first section reviews studies on work practices and position my work in relation to these studies. The second section presents the main conceptual ideas from CHAT and DWR. The third section presents an overview of additional theoretical perspectives. The chapter ends by revisiting the theoretical perspectives presented in the previous sections and suggesting a conceptual framework for analyzing the empirical material presented in this thesis and work practices and their transformation in general.

3.1. Work Practices - Related Studies

My research has a basic grounding in studies of work practices within the design field. According to Button & Harper (1996), the term “work practice” has been part of the traditional vocabulary for describing work-related activities. Karasti (2001, p. 26) describes work practice as the concrete and mundane activities of practitioners as they are encountered by the members of work communities in their everyday settings. In particular, work practices accounts for “the processes of interaction between practitioners and their use of the material media and tools as well as technological environment in the collaborative activities of producing intelligibility and interpreting meanings to be able to carry out their everyday work.” Moreover, work practices are concrete and situated; the social and physical context where work occurs, the arrangement of tools, the working environment etc., influence the particular character of a work practice. Particular activities are understood in relation to how they are embedded in the social and historical fabric of everyday work (Karasti, 2001; Sierhuis et al., 2007).
Work practices has been a central focus to most research on systems design (e.g. Suchman and Trigg, 1991; Suchman, 1995; Blomberg et al., 1996; Karasti, 2001; Blomberg et al., 2002; Bonacin et al., 2003). Despite diversity in scope and approaches used, what is at the heart of these researches relates to one of the most essential and invariable topics of systems design, i.e. bridging work practice and systems design (Karasti, 2001). They are concerned with understanding the context of use as a way of informing the design of technologies and information systems (IS). In this section, I present two of the approaches which relate to the present study.

One of the approaches that have been used in bridging work practices and systems design is ethnography. Those who argue for commitment on the part of ethnography in design often assert that human activities are socially organized (e.g. Suchman, 1987; Suchman and Trigg, 1991; Hughes et al., 1993; Suchman, 1995; Blomberg et al., 2002). Accordingly, when designing systems we are designing social relations. The use of ethnographic approaches in systems design has often been attributed to Lucy Suchman's book *Plans as Situated Actions* (Button and Harper, 1996). Suchman (1987; 1995), which proposes that in order for designs to be realistic, attempts to understand how people work is crucial. Because ethnographic approaches deal with actual practices in real world situation, they explore patterns of behaviour that can not be understood both rationally and intuitively (Harvey and Myers, 1995).

However, there is a difference between traditional ethnography and ethnography for design: while the former aims simply to describe and interpret cultures, the later aims to describe and interpret cultures for the purposes of designing a future tool which will change the culture studied (Blomberg et al., 2002; Barab et al., 2004). When done as part of the design process, ethnography reveals a deep understanding of people and how they make sense of their world. It contributes to the design of technologies that provide improved opportunities and conditions for users (Simonsen and Kensing, 1997; Blomberg et al., 2002). However, invisible work, or, work that goes unnoticed, including informal ways of knowing are not directly observable for ethnographers since ethnographers are not knowledgeable experts of experiences and practical skills in focus. In this regard, a key question is on how to integrate the invisible knowledge and experiences into design (Karasti, 2003; Hasu, 2005).
Participatory design (PD) is another approach used in bridging work practices and systems design. PD was initially developed in Scandinavia as a way to influence the democratization of working life and the design process by involving potential users in the design of tools and artefacts (Bødker et al., 1988; Bjerknes and Bratteteig, 1995; Kensing and Blomberg, 1998). The approach employs a variety of techniques to carry out design with the users, rather than for the users (Iivari, 2004). It is argued that the most vital factor for obtaining systems that meet users’ needs and requirements is users involvement in the design process to create a forum for users to input their thoughts and experiences (Bratteteig, 2004). The main interest in PD has been to reveal new ways of designing systems where the users’ interests and participation is at the top of the agenda.

My focus on everyday work practice relates to both ‘ethnography for design’ and PD approaches (see for example, Paper III and section 4.3 in Chapter 4). While design tools and methods such as PD, distributed cognition and contextual design have had a great impact on the practical issues of context, they still need additional methods on how to conceptualize contexts (Nardi, 1996b). Since context is crucial to my research (see my conceptualization of work practices in Chapter 1), I have chosen to further focus on and relate my study to theoretical perspectives that will allow me to analyze work practices as a collection of socially situated collaborative activities in which people, actions, meanings, communities, cultural histories, as well as cultural tools and artefacts come together to produce systemic transformation in organizational practices. The importance of these perspectives is their ability to explain what drives people to transform their work practices and how the transformation is shaped. One main theoretical perspective used in this thesis is Cultural Historical Activity Theory (CHAT).

Several researchers (e.g. Kuutti, 1991; Kaptelinin et al., 1995; Nardi, 1996b) have suggested that CHAT has promising characteristics for use as a foundation for understanding work practices. It provides a way to explain the developmental processes whereby communities or contexts are constantly changing and being changed through activities (Robbins, 2005). In addition, Macaulay et al. (2000) argue that CHAT provides an opportunity to move from ethnographic intuition to design insight. In the next section, I provide an overview of CHAT and describe the use of CHAT as a conceptual tool in analysing work practices and their transformation.
3.2 Cultural Historical Activity Theory (CHAT)

Cultural Historical Activity Theory (CHAT) or Activity Theory as it is also known, traces its roots back in the Soviet Union in the 1920s. Its basic foundations were laid by Vygotsky's concept of tool mediation and Leontiev's notion of activity. The theory has traditionally studied learning and instruction in the context of schools and other educational institutions (Engeström, 1987). It was only in the end of the 1980s when CHAT was introduced in Human-Computer Interaction (HCI) research (e.g. Bødker, 1989). Since then CHAT's ideas has been a viable means of analyzing the context and practice of the use of technologies in workplaces (e.g. Nardi, 1996b; Korpela et al., 2002). In general, the research field has expanded from educational institutions to workplaces in which the implementation of new technologies has become a pertinent research subject. These applications of CHAT have been encouraged by the potential seen in the theory for studying both learning (understood as reproduction of culture) and change (the creation of new cultural artefacts) in human activities (Kuutti, 1991; Engeström et al., 1999).

Vygotsky (1978) originally introduced the elementary concept of mediation: the idea that human's interactions with their environment are not direct ones but are instead mediated through the use of cultural tools, signs and desire. His approach opposed psychoanalysis and behaviourism, which focused on the study of the individual as a separate entity. He illustrated that cultural tools, signs and desire enable individuals to redefine and change their circumstances. In this regard, Vygotsky's connected mediation and agency as the genesis of voluntary actions in individuals (Yamazumi, 2007). Vygotsky's ideas were crystallized by Engeström in a triangular model of a mediated action, expressed as a triad of subject, object, and mediating artefacts (see Figure 3.1). However, in Vygotsky's approach the unit of analysis remained individually focused: mediation by other human beings and social relations was not theoretically integrated (Engeström, 2001a).

![Figure 3.1: The reformulation of Vygotsky's idea of mediated action (Engeström, 2001)](image-url)
Later on, Leont'ev (1978; 1981) expanded Vygotsky's concept to cover social mediation by developing a model of activities (see Figure 3.2). This model provides a distinction between activity, actions and operations and relates these terms to motives, goals and the conditions under which the activity is performed (Engeström, 1999a; Wilson, 2006). Leont'ev's model captures the fact that activities consist of goal oriented actions that are completed through operations influenced by specific conditions.

Incorporating Vygotsky's triangular model, Leont'ev's expansion can be expressed as follows: an individual (the subject) carries out a number of actions that are directed towards an object-related motive, assisted by a set of tools or mediating artefacts (Leont'ev, 1978; 1981). In the context of the present study the activity-action-operation hierarchy can be illustrated using the example of what may be going on in a doctor's consultation room. A doctor (subject) is engaged in an activity, for example, diagnosing a patient. An object in the sense of a goal is held by the doctor and motivates his/her activity giving it a specific direction. The object could range from understanding the patient's illness to recording the patient's information for keeping his/her medical history. To achieve the object, actions are taken by the doctor, and these actions are goal-directed. Different actions may be taken to achieve the same goal, such as asking the patient about how long s/he has been having pain (if any), any chronic disease in the family, and listen to the patient's heart beats. Conversely, different goals may be achieved by the same action. For example, asking the patient's family health history can result, at the same time, in revealing the relationship between the patient's current illnesses with any chronic disease in the family and the patient's historical health-related information. On the operation level, the doctor can use a stethoscope to feel the
patient's heart beats, use a pen and paper or typing in the computer to record the patient's information.

Leont'ev’s model of human activity has been criticised for putting much emphasis on the what side of activity (what is being done) and paying little attention to the who and how side of the activity (those engaged in carrying out the activity) (Davydov, 1999). It does not say much about the roles and responsibilities of individuals involved in carrying out the activity. However, the model helps to conceptualize the interrelatedness of various actions in an activity, and also how they are linked to the goals and shared objective of that activity. In addition to Vygotsky’s conceptualization, Leont’ev’s account focused on the social origins of intentional action. He articulates that individual agency do play a major role in giving a collective activity the necessary direction and continuance (Stetsenko and Arievitch, 2004; Engeström, 2006). Furthermore, Mursu (2002) argues that the identification of activity and action, or action and operation always depend on the interpreter’s sensitivity, making the difference between them not clear-cut or stable.

Drawing on the works of Vygotsky (1978) and Leont'ev (1978; 1981) among others, Engeström (1987) developed the concept that people are embedded in a sociocultural context with which they actively interact. The complex interaction of individuals with their environment can be examined using a historically evolving collective activity system (Engeström, 1987; 2000). An activity system comprises of the object of activity, the subject involved in the activity, artefacts and tools relevant to the activity, rules surrounding participation in the activity, the community relevant to the activity and the division of labour involved in the completion of the activity. Figure 3.3 depicts the core features of an activity system as illustrated by Engeström (1987).

![Figure 3.3: The structure of human activity system (Engeström, 1987)](image)
In more details, a *subject* is an individual or subgroup whose agency is motivated towards the solution of a problem or purpose. The *object* refers to the reason (purpose) individuals and groups of individuals choose to participate in an activity (Kaptelinin, 2005), and it is what motivates the existence of an activity. The relations between the subject and the object are not direct. Rather, they are mediated by *tools*, *rules*, *division of labour* and *community*. Therefore, mediation is one of the most important aspects of CHAT. *Tools* or *artefacts* refer to culturally produced means for changing the environment and achieving goals. The *division of labour* refers to the horizontal actions and interactions among the members of the community and to the vertical division of power and status. The *community* is the participants who share the same *object* that shapes and lends direction to the shared activity at hand. Within a community of actors there are bound to be *rules* and procedures each of which afford and constrain the goings on within a functional activity system. The *outcome* is the results or consequences that the subject finds once the activity is completed.

The elements of an activity system are not static; existing in isolation from each other. Rather, they are dynamic and continuously interacting with each other through which they define the activity system as a whole (Barab et al., 2002). Accordingly, the analysis of any activity system must consider the dynamics among all these elements. Each element of the activity system (Figure 3.3) relate to the other with contradictions between them serving to operate as a motive for change and development within the activity system itself (Cole and Engeström, 1993). The identification of contradictions in an activity system helps practitioners to focus their efforts on the roots and causes of the problems, which often give rise to for example, modified objects or mediating artefacts, rules or division of labour. Accordingly, activity systems change and develop by resolving their historically evolving internal contradictions (Engeström, 2000). In this regard, CHAT elaborates a conceptual apparatus for studying and mastering transformation processes.

The interpretation of CHAT used in this thesis is based on what Engeström (2001a) termed as the third generation Activity Theory and more elaborations from the application of CHAT in Human-Computer Interaction (HCI), Computer-Supported Cooperative Work (CSCW) and IS studies. I provide this formulation of CHAT in the
next subsection and further highlight key concepts with a particular focus on how they are applied in this study in section 3.2.4.

3.2.1. The Third Generation of CHAT: Core Concepts and Building Blocks

The formulation of what Engeström (2001a) termed as the third generation of CHAT suggests conceptual tools to account for dialogue, multiple perspectives and networks of interacting activity systems. It acknowledges that activity systems interact and overlap with other activity systems. In this regard, the elements of an activity system are always produced by some other activity. Likewise, the outcomes of an activity are usually intended for some other activity, either as a means, object or subject of the later (Korpela et al., 2002). The relationships among these activity systems cause multivoicedness in the elements of an activity system. Consequently, an activity system is always a community of many points of view, traditions and interests, both individual and collective.

To represent the plurality of different activity systems, Engeström (2001a) expanded the basic activity system model (Figure 3.3) to include minimally two interacting activity systems (Figure 3.4). In this interaction, the object of an activity system (e.g. the health care provision) expands from an initial state - object 1 (e.g. the problem of a patient) to object 2 (e.g. an outlook on the patient’s multiple problems) and a potentially shared or joint object 3 (e.g. a collaboratively constructed understanding about the patient’s life situation and care plan). By providing feedback to the respective activity systems, the third object (object 3) gives rise to a driving force for the transformation of the original activity system (Engeström, 2001a; Yamazumi, 2006).

![Diagram of Two Interacting Activity Systems](image)

Figure 3.4: Two interacting activity systems (Engeström, 2001; 2005b)
In the health care work practices, for example, there are at least two interacting and overlapping activity systems: that of health care services provision and that of the health information system (HIS). The two activity systems interact and overlap in the sense that they both involve the same subject and the health care services provision activity system produces data (the object) to be collected through the HIS activity system.

Seeing humans as participants in their activity contexts, CHAT aims at reconstructing contexts in practice so that individuals and their social partners and the activities in which they engage are continually transforming and developing in mutually integrated ways. Likewise, communities and contexts are constantly changing and being changed, which results in changed opportunities for development. This approach differentiates CHAT as a sociocultural study from cultural or cross-cultural studies in which culture and context are seen as variables that influence development (Robbins, 2005). From a CHAT perspective culture is not just race, ethnicity, and country of origin; rather it involves everyday activities, routines and experiences. Accepting this challenge from a CHAT perspective leads to approaches and methods such as Developmental Work Research (DWR), a relatively expanded application of CHAT in work, technology and organizations (Engeström, 1991; 2005b), which I describe in the next subsection.

3.2.2. Developmental Work Research

Developmental Work Research (DWR) is an interventionist approach for studying change and development in human activity and the organization of work. The approach is based on perspectives from CHAT and is oriented to understanding collective work practices in the process of change (Engeström, 2005b; 2005a; Miettinen, 2005). DWR approach assumes that the historical development of activity systems proceeds in the cycles of emergence, transformation and solving of inner contradictions within the activity system, referred to as an expansive cycle or developmental cycle (Engeström, 1987; 1999c; 2005b). These contradictions are historically accumulating structural tensions which emerge in the execution of day-to-day tasks making people to change their activities and simultaneously change themselves (Engeström, 2001). Identifying the internal contradictions of the activity system which have catalyzed development, can provide a collective mirror for those involved in the activity, helping them to
identify the sites or sources of discoordination, and suggesting potential avenues for expansive change (Engeström, 1990).

Accordingly, the analysis of contradictions in an activity system accords understanding of its developmental trajectory. They can be analysed into four levels (Engeström, 1987): primary, secondary, tertiary and quaternary (Figure 3.5). Primary contradictions refer to inner contradictions within each constituent element of the central activity system. Secondary contradictions appear between the constituent elements of the central activity system. Tertiary contradictions appear between the dominant form of a central activity and an introduced culturally more advanced form of the central activity. Lastly, quaternary contradictions appear between the central activity system and its neighbour activities within its network relations.

An expansive cycle details six stages in generating change (see Figure 3.6). The first is concerned with participants in an activity system questioning and criticizing aspects of existing practice. The second is an analysis of the situation to determine the causes identified during the questioning process. The analysis serves as a basis for planning a solution to the contradictions in the present praxis. The third is an attempt at modelling a new approach that addresses the issues identified in the first and second stages. Such modelling involves sketching the zone of proximal development (ZPD) for the collective activity system. The ZPD is a “collaborative construction of opportunities for
individuals to develop their abilities" (Lantolf, 2000, p. 17). It represents the difference between what a novice can accomplish when acting alone and what the same person can accomplish when acting with support from an expert and/or cultural artefacts (Vygotsky, 1978). However, it is important to note that during the process novices do not merely copy the expert’s capability; rather they translate what the experts offer them in their own ways.

The fourth stage involves an examination and testing of the model to establish its potential and limitations. The fifth is the implementation of the model in order to concretize its application to practice. The sixth stage involves reflection and evaluation of the model and a consolidation process where the outcomes of the model become a new and stable form of practice.

The phases of an expansive cycle represent possibilities that can be realized through active development work and conscious learning activity (Virkkunen and Kuutti, 2000; Engeström, 2005b). The cyclic nature of how people interact and refine their work practices as illustrated by the expansive cycle points out to the need for an iterative design process that can grow and change as the needs of the community change. With the sensitivity to tensions and openness to reorganization, the potential exists for older tools to be examined in light of more contemporary offerings. In this process, the IS
development becomes part of the transformation of the whole activity system to solve its contradictions. An expansive transformation is achieved when the object of activity is reconceptualised to embrace a radically wider horizon of possibilities than in the previous activity system.

Accordingly, new tools will not come from nowhere. They are built on innovative ideas emerging from the current work practice and its inner contradictions. Through the development and use of tools, human beings both change the activity that they are engaged in and transform their mental perceptions about that activity (Engeström, 1999b). However, the development can also be hampered because participants cannot develop an agreeable solution to the contradictions or do not recognize the systemic and collective nature of their problems and try to manage the situation by individual solutions (Virkkunen and Kuutti, 2000). In this situation, negotiation takes the form of improvisation and bricolage, namely, constructing solutions by means of ad hoc combinative tinkering with available imperfect resources and tools (Engeström, 2001b).

With DWR approach, what motivates the emergence and creation of new tools (such as new technologies and new IS) can be studied. How are work practices and interactions changed and reproduced during this process can as well be studied. DWR emphasises the skilful contributions of people throughout organizations that are essential to accomplishing work but too often unrecognized, the valuation of skills that are usually rendered invisible, and how skill is socially achieved in situated activity (Engeström and Escalante, 1996; Engeström, 2007). Consistent with Vygosky’s view of mediation and agency, human do not solely appropriate the cultural-historical and material resources available to them, but they also create new social and material forms, patterns of relation, and tools in expansive cycles of development (Foot, 2001).

### 3.2.3. The Use of CHAT in Information Systems and Related Research

The application of CHAT in IS derives from the work of Kari Kuutti (1991). Based on the fact that IS research is concerned with the emergence of new type of work brought by information technologies (IT), Kuutti suggested that the object of analysis in IS should be the work activity systems in all their aspects and dynamics. In this regard, CHAT
helps to integrate the individual and social levels involved in IS development. Since then, CHAT has been advocated and applied as an underlying framework in IS research (e.g. Korpela et al., 2000; Korpela et al., 2002; Crawford and Hasan, 2006). The main achievement of using CHAT from the point of view of information systems is the formation of a collectively shared comprehensive perspective which guides the long term development of tools as integral components of the activity system moving through its zone of proximal development.

Furthermore, CHAT has been applied to research on Human-Computer Interaction (HCI) (e.g. Kaptelinin, 1992; Kuutti, 1996; Nardi, 1996b; Kaptelinin and Nardi, 2006) and Computer-Supported Cooperative Work (CSCW) (e.g. Kuutti and Arvonen, 1992; Bardram, 1997; Mwanza, 2003). For example, Nardi (1996b) argued that the field of HCI has largely ignored the role of artefacts in human activities. In this regard, she advocated the use of CHAT as a proper framework for addressing this deficit. With a focus on design, researchers have advocated the use of CHAT as a tool for analyzing and understanding users’ activities and the way tools mediate activities in order to concretize and develop knowledge about future use situations (e.g. Bødker, 1991; Bødker and Greenbaum, 1994; Redmiles, 2002).

3.2.4. Key Elements of CHAT Relevant to this Study

The usefulness of using CHAT has been mentioned in the earlier section - mainly the transformation of work practices become understandable on the basis of the history and current contradictions in work activities. Two CHAT-based approaches were used in this thesis as the main analytical tools to analyze and conceptualize the empirical material (Kuutti, 1996): (i) studying interactions as embedded in the social context and (ii) dealing with the dynamics and development. These approaches help in studying and analysing transformation in work practices by describing an organizational context as an ensemble of multiple interacting elements as well as perceiving transformation in work practices as a dynamic phenomenon in which not only consensus and stability but also conflicts and breakdowns play a crucial role.
**Studying Interactions as Embedded in the Social Context**

CHAT and the concept of activity system are particularly suitable to be used as the starting point in studying contextually embedded interactions. From this perspective, context is not simply a situationally created space but is an entire activity system, integrating the subjects, the object, the tools, the community, rules and division of labour into a unified whole (Engeström, 1987). Work practices are conceptualized as networks of people, tools organizational routines and so forth. Accordingly, health care work practices are seen as an interrelated assembly of health care professionals (such as doctors and nurses), patients, laboratories etc. whose functioning is primarily geared to the delivery of patient care (Berg, 1999). Likewise, the HIS is viewed as an integral part of the day-to-day work activities of the health care organization in which it is to function. In this regard, the roles and tasks of health care professionals are intertwined with the functioning of the HIS and the architectures of their work environments.

In studying interactions as embedded in the social context, CHAT contains features like activity system, mediation, historicity, multivoicedness, and contradictions, which are considered essential in IS design and implementation discussions (Kuutti, 1996; Korpela et al., 2004). I now describe each of these features and its usefulness for this study.

**Activity system:** Engeström (2000) stipulates that the basic unit of analysis in CHAT is a historically evolving activity system seen in its network relations to other activity systems in which human participate. The basic structure of an activity system is defined in relation to seven constituents: object, subject, tool, community, rules, division of labour, and outcome. Accordingly, an activity is a systemic formation and mutual relationships exist between all its constituents as well as between its constituents and the constituents of other activity systems within the network. I have applied this concept in analysing both the transformation in everyday work practices surrounding the HIS as an activity system (Paper I) as well as transformation in work practices during the HIS design and implementation activities (Paper II).

For example, I conceptualized the HIS activity system studied in this research as consisting of the subjects who include doctors, nurses and health managers. The object of work is health care data. Tools include register books, paper forms, computers, pens,
calculators etc. The community consist of the covered population, patients attending the health facility, health care workers (doctors, health managers, nurses, donor agencies, etc.). Activities are guided with certain rules and procedures and the division of labour. The division of labour determines who is responsible for data collection in each health care department (e.g. the incharge of the department), report preparation and reporting at the district level (e.g. health information officers) and decision-making powers (e.g. heads of the HIS and managers at the Ministry of Health). The rules regulate for example, what data to collect, the reporting routines and the hierarchy of reporting. Finally, the outcome includes the intended health care information for decision making purposes. Changes in one element of the activity system may result in changes in other elements. This implies that, in designing an artefact or tool we also design new conditions of use for a collective activity (such as establishing new division of labour, rules etc.). Thus, designing and implementing a computerized system (tool) within the HIS activity system will lead to transformation in its other elements, not only the tool component (Paper I and II).

Moreover, a particular activity system does not exist in isolation but interacts with other activity systems. The HIS activity system illustrated earlier is part of a network of interacting activity systems, such as the health care medical work (provision of health care services), the health management activity system, the medical training activity system, etc (e.g. Paper II).

Mediation: Vygostsky (1979)'s conceptualization of mediation reflected the fact that human activity is always mediated by cultural means or artefacts, such as language and tools. With Engestöm (1987)'s extension the current key notion of mediation presents the view that an activity system is mediated by historically and culturally created tools and artefacts, on the one hand, and by social properties, such as community, division of labour and rules, on the other hand. Accordingly, an activity is always materially and socially mediated object oriented practice (Lehenkari, 2000). The health care organization studied in this thesis is characterized by a hierarchical way of working. In this regard, mediation by social properties is as important as mediation by tools and artefacts. With most decisions being done at the higher levels in the organization, health workers' activities at the lower levels are guided by specific rules, the division of labour and aspects from the community (see Paper I and II).
Historicity: The historical development of different elements in an activity is one of the key issues CHAT is emphasizing. In many occasions the recent state of affairs is difficult to understand without a reference to the historical development that has produced it. Activity systems are typically institutionalized working communities. Accordingly, participants themselves are analysed as historically and culturally formed activity systems. In CHAT perspective, tools are social entities that are developed and redeveloped as a result of historical social and cultural transformation that occur in the environment in which the activity is carried out (Kaptelinin, 1996). Keeping with the example of the HIS activity system described so far, the register books, paper forms and procedures for data collection and reporting have been accumulated over a long period of time; not only as a result of the historical evolution of the country’s health care system and of the health care organization, but also in response to changes and advances in health care practices and technologies (see Paper I and II). Understanding the HIS activity system thus requires understanding the historical evolution of its tools.

Multivoicedness: According to CHAT, different subjects (whether as individuals or a team) in the community bring with them their voice, that is, their interests and conceptions of the object and its development in the network (Wertsch, 1991; Miettinen, 1999). This can be through their position in the division of labour and/or their familiarity with the mediating tools available to them (Engeström, 2001a). Therefore, the concept of multi-voicedness helps in directing attention to the different actors’ varying interests, motives, and tools (including concrete technologies, knowledge, resources, and languages) for shaping the object.

Health care work is characterized by different stakeholders with multiple viewpoints, different needs, and inconsistent and evolving knowledge basis. When designing and implementing a computerized system for the HIS activity illustrated earlier, doctors and nurses at the health facility level and health managers at the MoH, for example, bring their own experiences from their work practices (see Paper II). However, the doctors’ and nurses’ experience may differ from that of the health manager due to their position in the division of labour and familiarity with the mediating tools at hand. Likewise, the doctors’ and nurses’ decision making power in relation to the design and implementation of the HIS are probably constrained by the health managers’ decisions (an example is in Paper I where the existing database is used despite of its limitations
because it is a requirement from the higher levels). In activity-theoretical analyses, mismatches between the different voices are examples of manifestations of contradictions within and between activity systems (Engeström, 1987).

**Contradictions or Tensions:** The existence of mutual relationships between the elements of an activity system, between activity systems, along with the multivoicedness of activities results in contradictions (Engeström, 1987; 2000). From a CHAT perspective the term contradiction is not to be understood as problem, obstacle, conflict, or breakdown. Rather, contradictions indicate a misfit within elements, between elements, between different activities, or between different developmental phases of a single activity (Kuutti, 1996). Accordingly, contradictions triggers innovation and change within the elements and/or within the activity system.

The concept of contradiction is probably the most important in this thesis, with the focus on transformation in work practices. In the context of work practices, contradictions, manifest themselves as disturbances, which interrupt the fluent flow of work (Helle, 2000). Analysing these disturbances as they occur in a given social practice provides a method for uncovering sources of change and transformation in work practices. I have applied this concept in both Paper I and II. Paper I focuses on contradictions in everyday health workers’ work practices surrounding the HIS and how health workers’ work around these tensions to get the work done. Paper II focuses on both the way contradictions triggered the need for HIS and the emerging contradictions during the HIS design and implementation process.

**Dealing with the Dynamics and Development**

In CHAT development is not only an object of study, it is also a general research methodology. With a DWR approach the basic research method in CHAT is not traditional laboratory experiments but the formative experiment which combines active participation with monitoring of the developmental changes of the study participants. Health care work is characterized by constant emergence of contingences that require ad hoc and pragmatic responses. Although some work follows routinized paths, the complexity of the health care organization and the never fully predictable nature of diseases result in an ongoing stream of unplanned events (Berg, 1999). Moreover, health care practices in low-income countries such as Tanzania are usually
financed with donor agencies, who have different and changing information requirements. These unplanned events and changing requirements have to be dealt with on the spot, by whoever happens to be present and with whatever resources happen to be at hand (see Paper I). Since an accurate prediction of the future activity is impossible, the strength of CHAT is in its acceptance of this possibility (Nathanael et al., 2002).

I expanded the analysis on dynamics and development in Paper II with the application of the expansive cycle of development. Embedded in the expansive cycle of development is an idea that the development is triggered by contradictions in the network and it proceeds by solving these problems (Hyppönen, 2007). This idea helps to surpass the narrow view of change as a step from one status quo to a targeted new stable state and to grasp the continuation of the qualitative change of the activity system (Virkkunen and Ahonen, 2004). Accordingly, the cycle is a tool for understanding the developmental dynamics of an activity. Since the study presented in this thesis involved the design and implementation of the HIS, I applied the expansive cycle of development to analyse the HIS developmental trajectory and recognize the contributions of the participants in different phases.

3.3. Additional Theoretical Perspectives

Although CHAT provided useful perspectives for understanding work practices and their transformation, there were several analytical dilemmas I confronted during the analysis of the empirical material in relation to the research aim and objectives. These dilemmas were: (i) understanding the needs of an individual as part of different collective activity systems, (ii) identifying how actors shape their own responsiveness to the emerging contradictions, and iii) determining what participants take from one social situation to the next during transformation and most importantly why specific forms or aspects of the older activity systems stay embedded in the evolved activity systems. Based on this I searched for additional theoretical perspectives to complement perspectives from CHAT. Taken together, these perspectives provide a conceptual framework that allowed me to conduct valuable theoretical and analytical work (see also Chapter 4 on data analysis and the role of theory). Barab et al. (2004, p. 45) argue
that, "it is through the application of complementary theoretical perspectives, especially when their assumptions employ us to acknowledge multiple scales and foci for analyses, that theory can have the greatest practical significance." I now provide an overview of these perspectives in this section and provide a more focused description on their contribution to CHAT perspectives and the analysis of the empirical data in section 3.4 and 4.4 respectively.

3.3.1. Situated Action

The situated action perspective was first introduced by Suchman in her book, Plans and Situated Actions: the problem of human-machine communication (1987). Since then there have been many papers written about situated action and its role in HCI studies (e.g. Blomberg et al., 1996; Carroll, 2003). Suchman (1987) argues that, every course of action is highly dependent upon its material and social circumstances focusing on moment-by-moment interactions between actors, and between actors and the environments of their action. In this regard, the situated action perspective stresses on examining how people's perceptions of the situation and specific actions are continually working together to determine the next step (Clancey, 1993).

Rather than subsume the details of action under the study of plans, in this perspective, plans are subsumed by the larger problem of situated action (Suchman, 1987). However, this does not imply that people do not have plans on how they carry out their everyday work practices. People often build a plan or plans of action before performing a task, but may need to change that plan depending on what is actually happening in a specific situation (Suchman, 2006).

Like the CHAT approach, situated action underscores the need to look at real activity in real situations by focusing on the dynamics of human activity. However, Nardi (1996a, p. 46) argues that situated action perspectives "do not account very well for observed regularities and durable, stable phenomena that span individual situations." In a situated action, people orient to a situation rather than proactively generating an activity rich with meaning reflective to their interests, intentions and prior knowledge. In this regard, the focus in a situated action is on moment-by-moment actions that lead to detailed descriptions of highly particularistic activities. The emphasis is placed on
the emergent, contingent nature of human activity, the way activity grows directly out of the particularities of a given situation (Béguin and Clot, 2004). This is in contrary to CHAT approaches in which the structuring of an activity is determined by human intentionality, the asymmetry of people and artefacts, human development, culture and society (Kaptelinin and Nardi, 2006).

This thesis recognizes the articulated differences and similarities between CHAT and situated action perspectives. More important to this thesis is their differences and how they can compliment each other in studying and analysing transformation in work practices and the driving forces to these transformation, which I describe in section 3.4 in this chapter.

3.3.2. The Temporal Theory of Agency

Emirbayer and Mische (1998) defines agency in relation to the temporal context of action. They argue that an adequate understanding of agency must be three dimensional: it must acknowledge influences from the past, orientations towards the future and engagement with the present. To understand agency we must focus on the dynamic interplay between these three dimensions and need to take into account how this interplay varies within different contexts of action. The key contribution of their approach is to explore agency’s temporal elements. Because agency is situated in the flow of time, actors continually reflect and reinterpret their orientation and action towards the past, the present and the future in response to emergent events (Biesta and Tedder, 2006).

Moreover, Emirbayer and Mische (1998) emphasize the importance of context, in which agency is seen as the capacity both to sustain social structures and to transform them. The combination of context and time indicates that it is not only important to understand agency in terms of individual’s lifecourse but also in relation to the transformation of contexts for action over time. This is one of the implications of this approach, which is important for this thesis. The approach calls for understanding agency by focusing on the ways in which individuals act by means of the environment rather than simply in an environment. It explores the fact that the achievement of agency always results from a combination of individual efforts and available resources.
such as technological, economic and cultural resources. It also helps to understand fluctuations in agency over time. Thus, agency is social and relational, a dialogical process where actors who are situated in the flow of time interact with others (Cousins and Robey, 2005). The analytic elements of the temporal theory of agency are defined as *iterational, projective* and *practical evaluative*, which I describe below.

*Iterational element:* Within the iterational element, the past is the most resonant chord. An underlying assumption is that subconsciously, past social experience is schematized and the actor has the ability to recall, to select and to appropriately apply these tacit or taken for granted skills or patterns of action that they have developed through past interaction. This does not suggest primarily routine behaviour, but instead defines the way that social actors engage with prior patterns of action. Accordingly, the iterational dimension allows actors to sustain identities, meanings and interactions over time.

*Projective element:* Within the projective element future possibilities dominate. Here social actors do not merely repeat the structures and action of past routines but reconfigure and invent new possibilities in accordance with their hopes, fears and desires for the future. The imaginative construction of the future is critical to this process. As actors respond to the challenges and uncertainties of social life they distance themselves from schemas, habits and traditions and reconstruct those traditions by generating alternative possible responses to problems. In essence, actors move beyond existing routines into the future, constructing changing images of where they think they are going, where they want to go and how they can get there from where they are at the present. Agency is, thus, linked to capacity to imagine the future that is different from the past.

*Practical evaluative element:* Within the practical evaluative element the present comes to the forefront. It entails the capacity of actors to make practical and normative judgments among alternative possible trajectories of action, in response to the emerging demands, dilemmas and ambiguities of presently evolving situations. Accordingly, routine and newly imagined projects must be adjusted to the present.

Although distinctly defined, all three dimensions are manifested in varying degrees within any concrete empirical instance of agentic action. At any given case, an action can be more or less related to the past, more or less directed towards the future, and
more or less responsive to the present. Central in this process is the re-shaping of the composition of the three dimensions that make up one’s agentic orientation.

### 3.3.3. Infrastructural Aspects of Information Systems

Studies on Information Infrastructures (II) focus on some interesting aspects that increasingly are met when designing and implementing IS. An II is the shared resources, materials, facilities that a community draws upon or uses when performing an action (Hanseth and Monteiro, 1997; Hanseth and Braa, 1998). It is characterized as shared, evolving, open, standardized, heterogeneous, and built on an installed base (Hanseth and Monteiro, 1997; Hanseth, 2002). An infrastructure evolves continually through conscious and unintended actions carried out by a number of different actors. It is open in the sense that it lacks clearly definable borders; new users, new applications, new linkages can be added at any time – hence the development (evolution) is a never ending process. As a foundation for communication and coordination, standardization plays a major role in the concept of II. IIs are also heterogeneous, in many regards; they include components of different kind – technological and non-technological (such as human, social, organizational etc). A focus on the installed base implies that an II is never developed from scratch. There is always something there both technical and non-technical; social practices, artefacts, organizational structures and very often a heterogeneous collection of different technologies.

The II perspective helps to emphasize that the social and technical are not separable but are instead constitutive of one another. Viewed from this perspective, transformation in work practices is not just a technical or contextual process, but one of transforming a heterogeneous and complex network. The development of an II needs to be recognized as an ongoing sociotechnical negotiation. Accordingly, the analysis of these negotiations has led to the application of Actor Network Theory (ANT) as a vehicle for describing the concrete technical and non-technical mechanisms which go into the building and the use of II (e.g. Monteiro, 2000; Aanestad, 2003).

Studies have pointed out to similarities and differences between CHAT and ANT approaches (e.g. Engeström and Escalante, 1996; Berg, 1997; Miettinen, 1999; 2001;
Kaptelinin and Nardi, 2006). A detailed account on these similarities and differences will not be covered in this thesis. However, I provide a brief overview on the pointed arguments for first, emphasizing on the use of CHAT as my main theoretical perspective and second, building the basis for the incorporation of infrastructural aspects of IS in the CHAT analysis applied in this thesis.

A major similarity among the theories is the input of technology in human life. Each theory recognizes that artefacts carry intentions and norms of cognition and form a part of the agency of the activity (Miettinen, 2001). Another commonality among CHAT and ANT is the claim that mind goes beyond the individual; consciousness is seen as a result of practical activity in a larger network with other people and tools (Kaptelinin and Nardi, 2006).

Despite significant similarities, there are important differences between the two theories with respect to individual subjects and tools or artefacts in practice. While CHAT develops an asymmetrical notion in which an active human subject (with needs, intentions and motives) engages in a meaningful activity mediated by tools, ANT define a network or system in which the relationship between its nodes (humans and non-humans) is more or less symmetrical (Miettinen, 1999).

In this thesis, the notion of installed base described by various proponents of the II perspectives provides a rich analytical tool with which to explore the sociotechnical processes and embedded practices that shape the HIS design and implementation process. The very nature of II and the notion of installed base imply that II are necessarily evolving and will inherit both the weaknesses and strengths of what already exists. A classical example in this regard is the design and evolution of the QWERTY keyboard layout (David, 1895), representing an installed base on which the current design of computer keyboards is still based and inherits its structure. Very much decided by temporally remote events, the persistence of QWERTY keyboard layout takes on an essentially historical character.

The installed base is understood not just as installed technical system, but as the interconnected practices, skills and technologies that are institutionalized in the organization. What the installed base is varies depending upon what kind of infrastructure you are looking at, but an important element in information
infrastructure is behaviour inscribed into already existing elements. Using the example of the Internet, Monteiro (1998) describes how the expansion of the Internet creates new patterns of use, whereas the infrastructure itself has a strong, conservative influence (arising from a large installed base of routers, users’ experience and practices, hosts, and specifications) that favours a situation of inertia and challenges the expansion processes. The inscription of existing elements and the likelihood that they will become more visible through time again reinforces the power struggle and the inevitability of the installed base. In this regard, the installed base is both the material to be shaped (changed, improved or extended) and, at the same time, an actor largely appearing to be outside of the designers and users control.

3.4. Summary: Suggested Conceptual Framework

In this chapter I have discussed the frame of references; the different perspectives that have influenced my understanding of work practices and their transformation. This section summarizes these perspectives by providing a discussion on how the additional theoretical perspectives (presented in section 3.3) complement the CHAT perspectives.

CHAT provides possibilities for analysing a historically developed collective activity system with a specific object of work. In this regard, it binds the individual, collective, and technological aspects of work together. It does not make a clear distinction between a collective object of work and substantial adaptation to individual objects of work (Iivari and Linger, 1999). The ad-hoc nature of health care work practices (Berg, 1999) and the interaction between multiple activity systems (within the same organization and between organizations) in this study necessitates for the analysis of situations in which health workers work on several objects of work at the same time (patients, HIS, and managerial issues) as well as health workers’ need to adapt to their individual object of work. To analyse these aspects I applied and complemented the CHAT framework with a “situated action” perspective. This perspective allows an analysis of how actor’s perceptions of the situation and specific actions are continually working together (Clancey, 1993) in addressing the object of work at hand. This in turn helps to explore the reasons and consequences of particular actor’s choices with regard to the multiple activity systems and objects of work in which s/he takes part.
CHAT's principal position on contradictions suggests that, for contradictions to function as sources of transformation, specific agentic actions are needed (Yamazumi, 2007). In this regard, agentive actions are a central focus in CHAT analyses, which Kaptelinin and Nardi (2006, pg. 32-33) describe as follows: “agency, the ability to act in the sense of producing effects, is a fundamental attribute of both the subject and the object.” However, since the interaction between the subject and the object is not a symmetrical relationship, “the agency manifested by the subject of activity is of a special character. It can be defined as the ability and need to act.” This view of agency seems limited in analyzing transformation in work practices. While it helps to analyze agency as the genesis of voluntary actions in human activity (Yamazumi, 2007), it does not provide possibilities to analyse how actors shape their own responsiveness to emerging contradictions.

Related to this, Chu and Robey (2008) argue that practice theories use agency to explain either inertia or transformation of work practice. In contrast, Emirbayer and Mische (1998)’s temporal theory of agency simultaneously considered both inertia and transformation and extends practice theories by also considering the practical contingencies affecting action in the present. “By disaggregating human agency into elements simultaneously oriented to the future, past, and present, the theory draws attention to the tensions among past practices, future expectations, and the practical dilemmas of the present. The theory thus affords an understanding of why future plans may not be realized in action” (Chu and Robey, 2008, p. 95).

The temporal theory of agency is particularly well suited to a study of transformation in work practices in general and within the health care organizations in particular. It does not simply locate agency in the ways in which actors respond to events in life, but suggest that agency has to do with actors’ capacity to critically shape their own responsiveness to problematic situations. In response to emergent events, actors continually reinterpret their orientation and action towards the past, the present and the future. The central practice of health care work is providing health care services while being temporally situated in the flow of time. In this regard, health care work is multi-dimensional, comprising temporal and contextual elements. When providing health care services, health workers who are situated within a specific time, space and context appropriate their tools for data collection, report preparation and reporting to
enable them to respond effectively to the changes in information needs within the health care organization. In this process, they build experiences and expectations with regard to the HIS activities, which may shape their actions during the design and implementation of a new HIS.

Furthermore, with a theoretical basis in CHAT and DWR, transformation in work practices are studied and represented in their wider activity context and against their historical background. That is, the outlining of developments within an activity system is based on a historical analysis of the emerged contradictions and their solutions. However, despite its emphasis on historical development of different elements in an activity system, CHAT places too little emphasis on what participants take from one social situation to the next during developmental transformation and most importantly why specific forms or aspects of the older activity systems stay embedded in the evolved activity systems. A similar argument is articulated by (Callanan, 2006; Callanan and Valle, 2008) who argue that in the context of children’s learning process, sociocultural approaches place too little emphasis on what children take from one social situation and bring to the next. Studies around Information Infrastructures (II) provide a promising perspective to theoretically explore historical resources that actors bring from one social situation to the next. In particular, the notion of installed base, comprising of both technical and non-technical components of the infrastructure (for example, health workers and their pattern of using the HIS tools, the structure and content of the tools, institutionalized practices) is not restricted to the historical dimension of the development of an information infrastructure, but also extends to what and why the various components of the old activity system get inherited in the new activity system during the work transformation process.
CHAPTER 4: Research Methodology and Methods

This chapter provides an account of the research methodology and methods used in this study. The chapter describes the research design and situates the research amongst existing research traditions in the information systems (IS) field. The chapter is divided into five sections. In the first section, a brief description of the ontological and epistemological assumptions framing IS research is provided. The second section presents the research paradigm adopted. The third section describes the research design; it covers how the empirical material used in the appended research papers was collected. The fourth section describes how the collected data were analyzed and the role of theory in data collection and analysis is described. Finally, the chapter provides a summary in section five.

4.1. Ontological and Epistemological Assumptions in IS Research: An Overview

Information systems research is multidisciplinary and multinational, involving human inquiry into specific domain of interest. Other disciplines such as computer science, sociology, business administration and psychology, contribute to studying the development, implementation and use of IS and information technologies (IT) within organizations (Becker and Niehaves, 2007). There are therefore different philosophical assumptions about what constitutes knowledge, which results in different strategies of inquiry, and consequently in different methods (Wade and Hulland, 2004). Orlikowski and Baroudi (1991) categorize inquiry paradigms within IS research according to their stance on three fundamental philosophical layers that are related to one another: ontological and epistemological assumptions, and methodological choices.

Ontological assumptions concern the form and nature of reality (i.e. claims about what exists, what it looks like, what units make it up, and how these units interact with each other). Epistemological assumptions are our assumptions regarding how we come to know about the world (i.e. our sources of knowledge, or how we make sense of reality). Methodological choices are the specific ways we choose in attempting to finding out
whatever we believe can be known (Guba and Lincoln, 1994; Rowland, 1995; Grix, 2002).

The three philosophical layers become related in the sense that the inquirer’s knowledge claims (ontological assumptions) informs his/her strategies of inquiry (epistemological assumptions) and his/her choice of methodology. As a result, any research endeavour mirrors a particular worldview of the researcher. Based on the ontological and epistemological assumptions adopted, Myers and Avison (2002) classify IS research into three traditions: positivist, interpretive and critical. While my aim is not to debate about the usefulness and critics over each tradition, I provide a brief description of each tradition in the following paragraphs of this section. My focus is on what does each tradition mean with regard to the IS research field. This description provides the basis for positioning my study within the IS research field.

Positivist research assumes that reality is objectively given and can be measured (Weber, 2004). Orlikowski and Baroudi (1991) describe an IS research to be positivist if there is evidence of formal propositions, quantifiable measures of variables and hypothesis testing. Understanding phenomena is thus primarily a problem of modelling and measurement. Examples of studies done from the positivist tradition include that of Sarker and Lee (2003) and Akkermans and van Helden (2002).

Interpretative IS research starts out with an assumption that access to reality is through social construction (Orlikowski and Baroudi, 1991; Walsham, 1995; Weber, 2004). The interpretive tradition assumes that the social world is relativistic and it is understood as a subjective and inter-subjective experience of those who are involved in its activities. In this regard, there are no predefined and independent variables, but a focus on the complexity of human sense-making as the situation emerges (Kaplan and Maxwell, 1994). Examples of interpretive research include that of Barrett and Walsham (1999) and Trauth and Jessup (2000).

Critical research assumes that reality is historically constituted, and produced and reproduced by people (Myers and Avison, 2002; Howcroft and Trauth, 2005). An IS research may be categorized as critical if its main task is seen as being one of social critique, whereby the focus is on changing social reality and promote emancipation (Myers and Avison, 2002; Klein and Huynh, 2004; McGrath, 2005; Pozzebon and

I describe the position of my study in relation to the described ontological and epistemological assumptions within the IS field in the next section.

4.2. Positioning the Study: Interpretive and Critical Traditions

The extant IS research literature shows that it is the social and organizational contexts of IS design, implementation and application which lead to the greatest practical problems (e.g. Newman and Robey, 1992; Walsham, 1993; Liu and Yu, 2004; Heeks, 2006). Thus, a need for a detailed knowledge about IS related problems and the nature of the settings in which these problems occur. Studying reality from this kind of perspectives has needed an approach to social inquiry that is characterized by the immersion of a researcher into a social situation (Forsythe, 1999; Myers and Avison, 2002). In this way, the researcher can share experiences of those being studied and better understand the behaviour, culture, tacit routines, etc., of the subjects in the social situation. With those arguments in mind, it is appropriate for me to state my own perspective at this point as a means of drawing a foundation for my own methodological choice.

In the research reported in this thesis, I made the following assumptions. Ontologically I assumed that, IS innovation and organizational transformation is a social and contextual process involving the interaction between those who are involved in the process and the environment in which the process is taking place. While not denying an external reality, my assumption concerns the fact that the reality of inquiry into facilitating the design and implementation of IS will be the product of our various interpretations of what is going on internally (i.e. within a particular context). Epistemologically, I assumed that, while some knowledge about IS innovation and organizational transformation processes can come from others (e.g. through reading different publications on the topic), it is only through our interaction with the environment that provides us with the knowledge and data we need to interpret and create and/or transform organizations. Furthermore, I recognized that people's ability
to consciously transform their work practices is constrained by various forms of social, cultural and political conditions. In this regard, the main task of the research is one of social critique, whereby the restrictive and alienating conditions of the status quo need to be brought to light, questioned and transformed. Based on my ontological and epistemological assumptions my research is located in between the interpretive and critical traditions.

The purpose of interpretive approach in IS research is to produce an understanding of the context of IS and the process whereby IS influences and is influenced by the context (Walsham, 1993; 2006). Through this approach, people in organizations are viewed as active sense-makers, engaged participants, and creators of organizational life. The interpretive approach give the research a greater scope to address issues of influence and impact, and to ask questions such as ‘why’ and ‘how’ particular technological trajectories are created (Orlikowski and Baroudi, 1991). In keeping with the interpretive tradition, this research has been explored through a combination of health workers’ and other stakeholders’ stated perceptions and actual (observed) work practices.

With interpretive research there is no fundamental fixed reality; a key feature of interpretive that differentiates it from positivism (Lee and Baskerville, 2003). Rather than capturing some pre-existing world presumed to be available out there, the researcher acknowledges the meanings that human subjects create, communicate and hold as part of the real world. This ontological and epistemological commitment is the basis of interpretive research making positivistic questions about its reliability and transferability redundant (Prasad and Prasad, 2002). The objective is to understand the deeper structure of phenomenon, which it is believed can then be used to inform other settings (Kaplan and Maxwell, 1994).

Within a critical approach, the researcher goes beyond interpretations to uncover the real structures in the material world in order to help people change conditions and build a better world for themselves (McGrath, 2005; Cecez-Kecmanovic, 2007). Critical approaches are interventions oriented and associated with participation and action research, with objectives to change practice and make a social critique. Through a deeper understanding of positions and experiences of health workers with regard to their work practices, I used my research as a catalyst for change by helping health
workers and health care stakeholders to design, implement and use the HIS. In this regard, I adopted a reflective account by connecting the acquired interpretations to broader considerations of transforming existing practices through the IS design and implementation process. A combined interpretive and critical approach provided a rich integrative view of transformation in work practices whereby as a researcher I critically facilitated networks and collaborative activities among health workers and transformation of these activities. Having described the philosophical assumptions underlying this research, the following section describes the sources and how the empirical materials were collected.

4.3. Methodological Choices: Developmental Work Research

The surfacing ontological and epistemological assumptions are the primary steps in determining the choices available from which to select a methodology for use in inquiry (Guba and Lincoln, 1989). Based on my philosophical assumptions and the research objectives and questions, I was able to identify the features of the methodology that suited my research. It was necessary to have a methodology that would allow me to do the following:

- allow for participation so that shared interpretations could be developed,
- take into account the fact that these interpretations would be emerging as more experience is accumulated,
- provide a way of understanding how participants interpret and respond to their contexts,
- provide ways of intervening in order to contribute to solving practice based problems and bring changes.

In this regard, I chose Developmental Work Research (DWR) as a methodological framework for my research. The term ‘framework’ in this research refers to the theoretical grounding that shaped the particular methodology within which particular methods are used (Gregory, 2000). Therefore, I do not claim that my research was carried out in a way that follows the model of DWR as depicted in Figure 3.4; rather, I made use of its principles to guide the data collection, analysis and presentation. While I provided detailed description on DWR in Chapter 3, in this chapter I address the use of DWR as a methodological framework in my research.
DWR is an approach based on Cultural Historical Activity Theory (CHAT) and was developed by Finish researchers for the study of work, organizations and technology undergoing developmental transformation (Engeström, 1991; 2005b). The core of the approach consists of learning, development, and research as basic elements for both practitioners and researchers. Through participating in a culture (everyday activities, routines, tools and experiences) both the practitioners and the researcher learns what is given in the culture.

To study transformation of work practices using a DWR approach is not only seeing work from the workers’ perspective, but also focusing on the dynamics of work that is present in what workers experience and sense. Transformation constitutes and is constituted by social, cultural, historical activities and practices. Transformation of work in this sense is seen from the perspective of the learner, the participant, in relation to the life that has to be lived, that is under construction and reconstruction and always in relation to conditions of life, as a conditioned human being. In this regard, DWR allows mutual collaborative efforts between researchers and the practitioners from the activity to be developed (Kyhlbäcka and Sutter, 2007; Meyers, 2007). The research makes visible and pushes forward the contradictions of the HIS activity system, challenging health workers to appropriate and use new conceptual tools (e.g. standardized paper forms and the DHIS in this research) to analyse and redesign their own practices.

Certainly, there are principles in common between DWR and action research methodologies such as, cooperation between researchers and practitioners, valuing practical knowledge, the researcher acquiring multiple roles and fostering personal and content-related change. However, in DWR the researcher’s task is not to try to change behaviour as in action inquiry or action science, but to start a dialogue about existing traditions in relation to the prevailing circumstances (Nilsson, 2000). By perceiving the activity in an organization as culturally and historically constituted the focus is transferred from individual's behaviour to the organization’s traditions and methods of working. The object of analysis and development is the whole collective activity system of the workplace (Engeström, 2005a).

I considered my research as a way to guide health workers into a joint discursive design, testing and implementation of new tools for health care data collection, analysis
and reporting. I tried to guide the health workers by letting the steps taken be theirs though I did challenge them to consider taking those steps. This was possible through a participatory design (PD) approach used in the HISP project, in which I participated as the designer. In this approach design is research through which the people who are considered ‘research subjects’ become part of the research process (Blomberg and Henderson, 1990) (for the origin of PD see Chapter 3 and also Paper III).

The PD approach used draws on various ethnographic research methods – such as observations, interviews, analysis of documents and artefacts, which are discussed in the next subsection in this chapter. These methods were used to iteratively construct the emerging design, which itself simultaneously constituted and elicited the research results. The goal of participatory design is not just to empirically understand the activity system under study, but also to simultaneously envisage, shape and transcend it through taking into account participants’ interpretations (Bratteteig, 2004; Clay, 2005). This process was a mutual learning experience. It helped me to increase my understanding of the actions and activities surrounding HIS within the health care organization. Through discussing about weaknesses in health workers’ working practices and providing them with possibilities for improvement, health workers learnt such things as how to record the health care data in an organized way, prepare reports and perform various data analyses. In this regard, my research became an instrument in improving their work practices.

4.3.1. Ethnographic Inspired Methods

As context is crucial to my research, methods that explore contextual networks of meaning are directly relevant. In addition, the fact that the study aimed at exploring transformation in work practices, it was necessary to use data collection methods that explores tacit work routines. This means that data collection and analysis required considering not only the views and perceptions of health workers within the health care organizations in study, but also the context in which these health workers work as well as things that health workers and designers take for granted. In this regard, I employed a qualitative research drawing on ethnographic data collection methods, which integrated narrative analysis of participants’ accounts of past and present
transformation efforts with analysis of documents and material traces of transformation.

Early ethnographic research in IS focused on the philosophical and epistemological divergence, with a critical edge (e.g. Benson, 1983; Suchman, 1987; Zuboff, 1988). Since then ethnographic methods have become more widely used in the field of IS in organizations. Studies using ethnographic methods in IS ranges from the design and implementation of IS (e.g. Crabtree, 2000; Gregory, 2000; Nandhakumar et al., 2005) to management and use of IS (e.g. Nguyen et al., 2004). The nature of these studies differs with domain, national emphasis, and team skills. Yet all have in common the goal of analyzing the contingencies of information-based work practices as situated in particular times and settings, and using that analysis to inform future user-sensitive and context specific IS development and implementation. Ethnographic methods that track the history and development of a practice have also become important in recent studies using DWR as a methodology. In these studies, the researcher (the ethnographer) takes action aiming at making visible organizational traditions in terms of for example, working methods and structures. The focus is directed towards creation of and dialogues about work practices, understood as culturally and historically produced (Nilsson, 2000).

One of the most valuable aspects of ethnographic methods is its depth (Myers, 1999). Because the researcher is in the field for an extended time, seeing what people are doing as well as what they say they are doing, s/he is able to gain an in-depth understanding of people, the organization, and the broader context within which people work. In this regard, ethnographic methods have a potential to depict undocumented patterns of work practices, workflow, power hierarchies and social relationships that are otherwise difficult to express verbally. The researcher is able to study organizations as the complex social, cultural and political systems that they are. As a result, opportunities and challenges that arise from contextual situations within organizations can be built on, instead of being avoided (Harvey and Myers, 1995).

In spite of their empirical strengths, ethnographic methods have been criticized as time-consuming (in both conducting the fieldwork and analysing the collected material), and that ethnographic data are closely tied to specific temporal and spatial contexts. This criticism means that ethnographic methods provides intensive (rather
than extensive) data collection and interpretive analysis that cannot produce insights that can be transferred to other situations and contexts. However, Forsythe (1999) argues that it is ultimately an empirical question of whether locally generated insights speak to other locales and regions. Ideally, through intensive fieldwork, strong familiarity with similar situations, through review of research findings in a wide variety of contexts, the problem of transferability can be overcome and lead to a more widely informed body of knowledge. Moreover, the limitation of ethnographic methods are outweighed by the fact that it is productive in terms of the amount and likely substance of the research findings, which provides in-depth knowledge of particular contexts and situations (Harvey and Myers, 1995).

**Methods for Data Collection**

Shaped by DWR approaches, in this research I employed ethnographic methods focusing on transformation. Data was collected through a combination of formal semi-structured interviews, informal interviews and discussions (during workshops and trainings), participant observation (during formal and informal interviews, workshops and trainings), and documents analysis. The data collection took place for a period of two years in the Mainland (January 2005 – January 2007) and one year in Zanzibar (January 2006 – January 2007).

While I consider the formal semi-structured interviews, informal interviews, discussions and participant observation as my primary sources of empirical data, the documents analysis forms the secondary source of empirical data. A combination of these methods helped me to identify consistent patterns of thoughts and practices and to investigate the relationship between them through comparison. Collecting systematic observational data, interviewing a range of practitioners, and addressing disparities between observed and reported phenomena helped to provide a more complex picture of social processes (Forsythe, 1999).

**Semi-structured Interviews**

The interviews I conducted were semi-structured based on both formal and informal arrangements with informants. The key informants included health workers at the health facility level, health managers at the district, regional/zonal and national levels,
and vertical programme managers mainly at the district and regional levels. Interviews were in most cases conducted with single individuals, but occasionally two to three health workers were interviewed together (especially in the case of informal interviews). The total number of informants was 84 (31 in the Mainland and 53 in Zanzibar), whereby a total number of 97 interviews were conducted (41 in the Mainland and 56 in Zanzibar) (see Table 4.2).

Each interview session began by explaining to the informant the aims of the interview followed by questions in a prepared interview guide (see Table 4.1 for sample questions). Moreover, the informants were assured on the confidentiality and anonymity of their names in the reporting of the given responses. The interviews were conducted in a conversational style, with informants encouraged to expand and elaborate their answers as much as possible rather than restricting answers to factual issues only. In this regard, the interview guide was used as a reminder of the topic areas to be covered.

The interviews took place within the health workers’ working environment, most of the time in individual health worker’s offices. The time ranged from 45 minutes to 1 hour for formal interviews and 30 minutes to 2 hours for informal interviews. The time for informal interviews depended on the particular health worker’s available time. In cases where the health worker had time (especially during the afternoons when there are not many patients to attended) the interviews took longer time. While the identification of health workers to interview was via a nested interviewing approach (Lamb et al., 2003), I tried to retain the possibility to choose health workers for interviews. Consequently, I found myself deciding who, when, and how to interview, as the fieldwork was progressing. This was partly based on a continuous assessment of my knowledge and judgement as to how my fieldwork might best be developed further at that particular time and partly based on the health workers’ time availability.

While the interview guide questions were developed in English, Kiswahili language was used in conducting the interviews. Kiswahili is a national language in Tanzania (see Chapter 2) and it is the language that is most comprehensible to the researcher and the research participants hence facilitating easy communication and understanding, which is indispensable to valid social research. All the interviews were briefly documented in a note book during the interviews, in a mix of Kiswahili and English languages, and then
expanded at the end of the day. For the purpose of analysis and presentation the expanded interview notes were written in English only. During the interviews, I noted down direct quotes from the interviewees (see the appended papers for sample excerpts from the interviews).

Table 4.1: Sample questions for the interview guide

<table>
<thead>
<tr>
<th>Organizational level</th>
<th>Broad Themes</th>
<th>Sample question for the interview guide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Facility</td>
<td>Daily recording and reporting of data:</td>
<td>- <em>What tools are used for data collection, report preparation and reporting?</em></td>
</tr>
<tr>
<td></td>
<td>- The use of register books and forms.</td>
<td>- <em>In what ways are the tools in use facilitating or constraining the data collection, report preparation and reporting process?</em></td>
</tr>
<tr>
<td></td>
<td>- Report preparation and transmission to the higher levels</td>
<td>- <em>How do health workers deal with the constraining aspects of the tools?</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <em>What are the different kinds of people needed to the work (data collection, report preparation and reporting)</em></td>
</tr>
<tr>
<td>District</td>
<td>Data handling practices:</td>
<td>- <em>What other systems are used for data collection, report preparation and reporting?</em></td>
</tr>
<tr>
<td></td>
<td>- In both the paper forms received from the health facilities and the computer system at the district level</td>
<td>- <em>What are the informal procedures that facilitate the way in which the HIS activities proceed?</em></td>
</tr>
<tr>
<td>Regional and Ministry of Health</td>
<td>Data handling practices and HIS management in general</td>
<td>- <em>What is the history of how the HIS activities came to be as they are now?</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <em>What are the formal rules that guide the information flow (reporting process) within the health care organizational hierarchy?</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- <em>Do health care stakeholders get information through the existing HIS?</em></td>
</tr>
</tbody>
</table>

Although Table 4.1 categorizes sample questions from the interview guide according to the health care organizational levels, it is important to note that some of the questions (e.g. *In what ways are the tools in use facilitating or constraining the data collection, report preparation and reporting process?*) were applied at multiple levels.

During my masters fieldwork within the health care sector in Tanzania Mainland in 2002, health workers were not comfortable with being audio recorded, fearing that they might be broadcasted on the radio. I asked for the possibility of recording the interviews during this research. But they still expressed their concerns and as a result, I could not use audio or video recording. However, through frequent visit to the field and continuous interaction with the informants, I could ask for further clarification on issues that I had forgotten or did not understand from the previous interviews.
**Participant Observation**

Observation is the most often used data collection method in ethnographic techniques. It occurs in situ, which requires access to the environment under study. In this regard, the observer (the researcher) lives among the people in the environment and gets to know it as an insider while simultaneously keeping a professional distance (Atkinson, 2001). Through being in the environment under study, the researcher keeps track of events, ask questions, document what s/he observes and get to know people.

In this research, I played a role of a participant observer whereby I had personal contact with health facilities and health workers in order to have a depth understanding of the actual work practices surrounding the HIS as well as understanding of what informants said during the interviews. I spent approximately 20-30 hours a week throughout the research period observing activities being carried out while documenting what I observed in field notes. I observed activities and events in terms of working environment, tools used, how tools are being used, time spent, and processes followed during health care data collection, analysis, report preparation and reporting. Moreover, several photographs were taken during the observation sessions. These photographs helped in exploring the details of observed work practices. Figure 4.1 presents some examples of photographs from two different health care levels.

![Figure 4.1: Some illustrations from the observation sessions in the field work.](image)

A. Health worker entering data in the DHIS

B. Participating in report preparation
The observations took place partly during the interview sessions and mainly during my participation in the HIS design and implementation processes as a member of the HISP project. Moreover, informal talks and discussions have also played an important role during my observation sessions in the field. My observations involved a wide context of the social and natural environments of health workers and their interactions with information systems. Based on that, I was able to see and interpret the health care activities through intensive interaction, for example, by participating in their daily activities such as report preparation.

**Workshops and Meetings**

During my research in Zanzibar, a series of workshops were organized as part of the HIS design and implementation process. While some of the workshops and meeting aimed at revising the data tools, some aimed at giving feedback to users on their performance with regard to the new HIS. My role in the workshops was twofold: first I participated in the workshops as a researcher, and second I functioned as a designer. The latter means that, I was an actor in the process and thus my research contributed to the HIS design and implementation process. The main reason for being an actor in the design workshop was that my role in the whole project was active and it was practically impossible to stay in the background as an observer during the workshops. This role, however, introduced me to the dynamics in HIS design, and to experience at firsthand the ways users make their activities understood to designers. During the workshops and meetings I took notes and documented statements from the participants about the processes and issues being raised and addressed.

**Training Health Workers**

As stated earlier my research was done as part of the ongoing initiatives of restructuring and strengthening the HIS within the Tanzanian health care sectors: Mainland and Zanzibar. Training as one way of institutionalizing these activities, has been conducted to health workers at various levels of the health care system. Being part of the HISP team in both Mainland and Zanzibar, I participated in training health workers on the use of data collection forms, the DHIS as well as HIS in general.
The training sessions that I actively played a role were based at the health facility and district levels. In most cases, we (me and other HISP members) conducted on-job training in the form of discussions as a way of solving problems that health workers faced with regard of health care data collection, analysis, interpretation and the use of data collection tools in general. Parallel to solving problems in specific areas, several formal trainings (e.g. the HIS course conducted at the University of Dar es Salam) were conducted as part of institutionalizing the new working routines. In these cases, health workers from different health care organizational levels joined in one particular session and learnt issues such as how to use the new introduced tools, discuss and share experiences on routines such as how to calculate indicators.

Table 4.2: A summary of the Interviews conducted, observed areas and analysed documents

<table>
<thead>
<tr>
<th>Health care organization</th>
<th>Type of informant</th>
<th>Number of informants</th>
<th>Total number of interviews conducted (with repetitions)</th>
<th>Observed areas</th>
<th>Type of analysed documents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Tanzania Mainland</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In charge of the health facility</td>
<td>10</td>
<td>15</td>
<td>tools used how tools are being used time spent and processes followed during health care data collection, analysis, report preparation and reporting</td>
<td>- health performance reports at health facilities and the district level</td>
</tr>
<tr>
<td></td>
<td>District information officer</td>
<td>2</td>
<td>4</td>
<td></td>
<td>- district plan reports</td>
</tr>
<tr>
<td></td>
<td>Members of the council health management team (CHMT)</td>
<td>8</td>
<td>10</td>
<td></td>
<td>- HIS implementation plan</td>
</tr>
<tr>
<td></td>
<td>Regional information officer</td>
<td>1</td>
<td>2</td>
<td></td>
<td>- the HIS guideline manual, and data documentation</td>
</tr>
<tr>
<td></td>
<td>Vertical programmes coordinators</td>
<td>6</td>
<td>6</td>
<td></td>
<td>- quarterly and annually reports</td>
</tr>
<tr>
<td></td>
<td>Health statisticians and Planners at the MoH</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Zanzibar</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>In charge of the wards and clinics</td>
<td>32</td>
<td>32</td>
<td>tools used how tools are being used time spent and processes followed during health care data collection, analysis, report preparation and reporting</td>
<td>- existed data collection and reporting tools</td>
</tr>
<tr>
<td></td>
<td>Health statisticians within the hospitals</td>
<td>4</td>
<td>4</td>
<td></td>
<td>- HIS development and implementation plans and progress reports</td>
</tr>
<tr>
<td></td>
<td>In charge of the health facilities</td>
<td>5</td>
<td>6</td>
<td></td>
<td>- minutes of the meetings and workshops</td>
</tr>
<tr>
<td></td>
<td>Vertical programmes coordinators</td>
<td>4</td>
<td>5</td>
<td></td>
<td>- health care sector strategic plans</td>
</tr>
<tr>
<td></td>
<td>District information officer</td>
<td>5</td>
<td>5</td>
<td></td>
<td>- annual reports</td>
</tr>
<tr>
<td></td>
<td>Health statisticians and Planners at the MoH</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>84</td>
<td>97</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Documents Analysis**

Documentary sources in this research were used to provide background information and an understanding of the health care organization’s structure, functions, working routines, and rules and procedures in both Tanzania Mainland and Zanzibar. The analysed documents include: the national health policy, health sector strategic plans, health district plan and the health technical review report (see Table 4.2).

For Tanzania Mainland where there was a working national HIS prior to my fieldwork, the analysis of the HIS implementation plan, reports and manuals provided specific background information on the initiation of the design and implementation of the HIS (MTUHA system). In Zanzibar, the HIS design and implementation process produced progress reports, which included the observed experiences, and what should be done in the future phases of the implementation process. Additionally, by examining data collection and reporting forms and registers, important workflow details were revealed.

**4.3.2. Reflection on the Methods of Data Collection**

Interviews are certainly one important way to understand people in ethnographic studies. In particular, interviews helps to reveal the meanings people bring to bear on places where they live and work (Zussman, 2004). Aiming at exploring tacit routines, I did not take for granted that what the informants said in the interviews is what they do or what they will do. In this regard, I treated the interviews as very particular type of narratives, ripped out of the ongoing context of social life. This is based on the fact that what people do is not always the same as what they say they do, what they say they should do and what they do (Forsythe, 1999; O’reilly, 2004).

What people say is important as it reflects their goals and attitudes as well as perceptions and aspirations of being seen in a certain light. What people do is just as important since actual activities can reveal more about people than what they say (Zussman, 2004). Thus, to explore the gaps between what people say and what they actually do I conducted observations. For example, in one of the hospitals the informant said that they get data about the number of beds that are occupied in a month from the
bed state forms (forms that the health worker on duty is supposed to fill in every single night). However, during my fieldwork, I observed that health workers who are on duty do not fill in these forms because they get overwhelmed with so many activities (since only one health worker is on night duty for each ward). Instead, they have a register book that they record the details about each patient including the date of admission and the date when the patient is discharged (something that they do not have to do every night). Through the date of admission and the date of discharge, the health workers get to know the number of days that the patients spent in the ward, which in turn is used to calculate the bed occupancy rate at the end of the month.

The interviews were conducted in Kiswahili because language is essential for obtaining a valid understanding of social phenomena (Atkinson and Silverman, 1997). The language we master influence our research, including ourselves, the researched field, and the ways in which we collect data, address issues, and share ideas with those who speak the language we speak (Usunier, 1998).

In many cases, the documents do not depict the organization’s existing situation because organizations evolve over time and documents become outdated (Ellis et al., 2003). Moreover, organizational documents are in most cases not transparent representations of organizational routines and decision making processes. In this research, I treated the health performance plans and reports as social facts rather than as firm evidences to what they report, that is, I approached them for what they are and what they are used to accomplish. My approach to the analysed documents based on the fact that what organizations or people plan to do and/or what they report may not necessarily be the same things that they actually do (Forsythe, 1999). Therefore, in order to understand the total context of the real working practices I had to compare what is presented in the plans and reports with what I was observing together with the informants’ descriptions from the interviews (Silverman, 2004). For example, while it is written in the HIS manual (in Tanzania Mainland) that health facilities are supposed to report after each three months, the interviews and observations revealed delays in reporting due to various contextual issues such as lack of reporting forms and transport from the health facility to the district level.
4.4. Data Analysis and the Role of Theory

The data collection and analysis were intertwined such that analysis occurred as the data was collected and led to further data collection and analysis. This is inline with Myers and Avison (2002)’s argument that, in doing qualitative research, there is no clear distinction between data collection and analysis. The analysis of qualitative data is a continuous process that starts in the research field during the data collection process.

The data analysis in this research involved subjecting the field notes to interpretation through the use of themes (Miles and Huberman, 1994). Within the interpretive account, the researcher can utilize social theory in order to gain insight into a social situation (Walsham, 1995). I used principles from CHAT and DWR as my primary analytical themes for categorizing data from the interviews, observations and analysed documents. The categorization and interpretations was done through triangulating data from these multiple sources. I started the data analysis by classified the empirical material according to the components of the HIS activity system: subjects, object, tools, division of labour, rules and the community. Then I examined the relations between health workers (referred to as subject) and the object of activity (health care data) as mediated by:

i) tools (both paper forms and computer based software ),

ii) division of labour (within the same health care level such as within the district level and between levels such as between the health facility level and the district level),

iii) rules (who or which health care level is supposed to collect what data, report where and when),

iv) community (those who share the object of activity).

The gathering of data under a specific theme was facilitated by the use of a word processing package, with its copy and paste functionalities. I defined and presented the component structure of each of these instances of the HIS activity system using Engeström’s (1987) activity system triangle (see Figure 3.3). However, the identification, classification and presentation of the elements of the HIS activity system did not follow a direct step-by-step process. It required me to engage in a reflective process in which I drafted and redrafted possible HIS activity system triangles based on new information shared by participants as my data collection progressed. After I drew
the activity systems triangles I presented them to participants for checking purposes and gained their input for revisions.

The activity system triangles provided a means with which to differentiate between structural elements of the HIS activity system and yet to analyse their systemic relationships. The main activity-theoretical concept used in analysing these systemic relationships is that of contradictions (systemic tensions). CHAT regards contradictions within and between components of the activity system as moving forces of change and development. In this regard, applying CHAT during data analysis involved identifying those contradictions that characterize the HIS activity system in its daily use and in the overall design and implementation process. This went in parallel with identifying attempts by participants in the HIS activity system to solve the arising contradictions.

The identification of contradictions within and between the elements of the HIS activity system and their solutions helped to reveal two aspects of the empirical material. First, it made me realize that there are other activity systems within and outside the health care organization that interacts and overlaps with the HIS activity system. In this regard, I started to explore the existed multiple activity systems as well as their overlaps and interactions with the HIS activity system. Second, it revealed the historically progression and transformation in the HIS activity system. Such progression includes issues such as, what new tools are designed, for what purpose are the tools being designed, who uses the designed tools and their impact on the division of labour and rules. Moreover, I used the model of expansive cycle of development from CHAT (Figure 3.6) to analyse the HIS design and implementation process, as it manifested itself as solutions to the internal contradictions in the old HIS and in its interactions with other activity systems.

Studying the HIS design and implementation process involves openness and sensitivity to data and unexpected elements that become known as the study progresses. Although theory can provide insightful guide in research, “there is a danger of the researcher only seeing what the theory suggests, and thus using theory in a rigid way which stifles potential new issues and avenues for exploration.” In conducting interpretive studies, researchers have to preserve a considerable degree of openness to the field data (Walsham, 2006, p. 105). This argument is in line with ethnographic tradition, which
highlights the need for the researcher to remain open to the elements that cannot be
codified during the fieldwork research (Forsythe, 1999).

The iterative process of identifying, classifying and presenting the elements of the HIS
activity system and its interactions with other activity systems made me realize that
there is more in the empirical material with regard to transformation in work practices
than what I could analyse through the CHAT perspectives. This means that, as the data
analysis progressed, additional features on transformation processes emerged from the
empirical material. These features centred on three main issues: (i) the needs of an
individual who is part of different collective activity systems, which sometimes differed
and even created conflicts, (ii) how actors shape their own responsiveness to the
emerging contradictions, and iii) what characterizes technological and social aspects of
the system that participants took from one social situation to the next during
transformation.

To unpack the empirical material associated with the first issue I relied on situated
action perspectives and its emphasis on the way an activity grows out of the
particularities of a given situation. For the second issue I developed themes based on
the temporal theory of agency and its three dimensions (past, present and future), with
an additional theme on technology materiality. For the third issue I relied on the notion
of installed base from studies on information infrastructure. (See Chapter 3 on
additional theoretical perspectives). Therefore, in my data analysis I engaged in a
reflective process examining both the data and how the data informed the theoretical
development of CHAT.

4.5. Summary of the Research Methodology and Methods

This chapter reviewed the ontological and epistemological assumptions underlying IS
research. Based on the review, I described the ontological and epistemological
assumptions that led my choice of interpretive and critical research approaches. I
identified the methodological features that were necessary to study the interplay
between transformation in work practices and IS design and implementation process. I
then explored the match between the identified features and Developmental Work
Research (DWR) as my methodological framework for this research. I also argued that I
chose to collect qualitative data drawing on ethnographic data collection methods because they allowed me to explore tacit routines within the health care work practices among other features. A summary of the research approach and methods used in conducting this study is highlighted in Figure 4.2.

Figure 4.2: Research approach and methods used in conducting this study
CHAPTER 5: Empirical Findings

This chapter presents the empirical findings of this study, which draws upon four papers. The chapter is divided into two sections. The first section provides a summary of the individual appended papers. The chapter ends with a table summarizing the aim, data collection methods, theoretical concepts of analysis and the key findings from these papers.

5.1. Summary of Papers

The empirical findings included in the four papers are based on my fieldwork in two health care organizations: in Tanzania Mainland and Zanzibar (see Chapter 2). I chose to present Paper I first because it mainly draws on data during the piloting phases of the Health Information System Programme (HISP) activities in Tanzania Mainland. The paper opens up, in more general terms, the different issues that surround everyday health information system (HIS) practices. It highlights transformation in work practices, which started without the design and implementation of the HIS. The other three papers highlight the concrete actions and outcomes related to transformation in work practices that occurred with (during) the HIS design and implementation process. Paper III and IV relate in the sense that the findings in Paper IV extends the findings in Paper III and they both draw on the same setting. In addition, some of the events analysed in paper II, III and IV took place synchronously.

5.1.1. Paper I


This paper is based on my fieldwork in Tanzania Mainland. During my fieldwork, HISP was conducting pilot studies in two health care districts. In this regard, the paper aimed to conduct a situational analysis in order to develop implications for the HISP activities...
in particular and HIS design and implementation processes in general. The paper focuses on the situatedness of work practices and organizational culture as key sites for understanding the cultural-historical constitution of co-existing modes of practice and potentials for change. The aim is to understand how health workers’ working practices are influenced by the context of their situation, including the interaction between multiple organizations. With the use of ethnographic research methods, the findings draw on the points of views of potential users of the HIS (health workers at the health facility and district levels). These views were analysed and presented through the lens of Cultural Historical Activity Theory (CHAT) with its focus on contradictions or tensions as necessary sources for transformation, complemented by situated action perspectives.

The findings and analysis shows what happens when there are tensions in work practices. They reveal tensions in work practices due to situational, individual, and organizational factors of work, including the interaction between multiple organizational contexts. Three main categories of tensions are revealed: tensions between various practices and resources, tensions between the demands from above and the data collection and reporting tools, and tensions between different organizational contexts.

In their everyday work practices, health workers reflect upon the emerging tensions and search for solutions. For example, they create hand drawn forms for collecting the data demanded by higher levels as well as using excel spreadsheets for data analysis and report preparation. In this process, the health workers reflect upon a number of sources such as medical training, HIS concepts in use and previous data collection tools. This reflection is in most cases conducted as a collaborative action between health workers from different health care departments within the same level (e.g. the district information officer and the district nurse officer) or between health workers from different levels (e.g. the district information officer at the district level and the person in charge of the health facility).

The ‘situated action’ perspective was employed to analyse how work practices and organizational culture are situated. The findings indicate that, while managers at higher levels organize HIS activities for the grassroots levels, distribution of work still happens within a specific level. The revealed distribution of work tasks include issues such as,
the district management officer (DMOs) delegating emergency report preparation tasks and roles to the district information officer (DIO), especially when s/he (DMO) has to present something in a management meeting; the DIO performing both health care information and health care services provision duties.

Another finding is with regard to the interaction between multiple organizational contexts and their impact on HIS activities. Health workers in private health facilities are confronted with tensions that results from their participation in an activity with two different objects of work. These tensions centres on the need to pay taxes, since providing health care services is a way of earning income for them as individuals and the need for reporting health care data through the HIS activity system. In this case, our findings indicate that health workers at the private facilities follow the work practices that facilitate their business activity system whereby they record and report less patients as compared to the actual attendance in order to pay less tax to the tax organization.

5.1.2. Paper II


This paper draws on the HIS design and implementation process within three levels of the health care organization in Zanzibar: the health facility, the district and the Ministry of Health (MoH) (Figure 2.5 and 2.7 in Chapter 2). The HIS design and implementation process and the respective outcomes were presented and analysed through the six phases of an expansive cycle (Figure 3.4 in Chapter 3) from CHAT. The findings and analysis captured and explored the developmental trajectory of the HIS activity system before and during the HISP project initiatives, as it manifested itself as solutions to internal contradictions in the old activity system as well as in its network relations with other activity systems. Contradictions are presented and analysed based on four levels: primary, secondary, tertiary and quaternary (Figure 3.5 in Chapter 3).
The findings reveal several activity systems within and outside the health care sector, that interacts and overlaps with the HIS activity system. Based on the research focus (within the health care organization) as well as how immediate is the impact of a particular activity system on the development of the HIS activity system, the paper focuses on three activity systems: the health care provision activity system, the health management activity system and multiple activity systems of the vertical programmes.

The findings revealed some of the elements that are shared among the four activity systems. For example, some of the health workers (subject) have to participate in all the four activity systems. Likewise, health care stakeholders such as donors (community) participate in all the four activity systems. The four activity systems have a shared object (quality of health care services) as well as a shared outcome (improved health of the population). In their interactions, the HIS activity system is seen as a tool producing activity for the health management activity system as well as for the vertical programmes activity system; it is supposed to produce information for decision making. Likewise, the health management activity system and the vertical programmes activity system are tool producing activities for the HIS activity system; providing data collection, analysis and reporting tools.

While the health care provision activity system is the object (health care data) producing activity for the HIS activity system, it is also seen as a tool (health care data) producing activity for the vertical programmes activity system. This is based on the fact that vertical programmes could obtain health care data directly from the health care provision activity system without passing through the HIS activity system. Furthermore, the findings revealed that this network was deeply fragmented because of differing objects between the health management activity system and the vertical programmes activity system, which resulted into different and separate tools for the HIS activity system. This description is not exhaustive but rather provides examples of network relations that form the basis for the revealed contradictions during the developmental trajectory of the HIS activity system.

The revealed primary contradictions include: the existence of different tools for data collection, which sometimes collect similar data; lack of tools for data analysis; lack of consensus on a systems for data collection among the different health care stakeholders. Secondary contradictions include: the existed tools not able to fulfil the
need for data; health workers having to fill in so many forms and report similar data to multiple health care stakeholders; lack of standardized reporting routines.

Tertiary contradictions include: health workers not able to use all the DHIS functionalities due to the fact that the previous HIS practices were mainly paper based and also they did not have skills in using computers; health workers did not understand some of the new data sets; new reporting routines and procedures that health workers were not used to; vertical programmes requiring immediate results from the MoH; some of the old tools being used in parallel with the new tools; unclear roles and responsibilities with regard to health care data management; non-institutionalized procedures for collecting some of the data; health workers not understanding some of the elements (especially those written in English only) in the new paper forms.

Quaternary contradictions include; contradictions between the HIS activity system and the health management activity system (the collected data not facilitating decision making); between the HIS activity system and the health care provision activity system as well as the vertical programme activity system (the same health workers have to participate in both activity systems, the HIS not able to fulfil the vertical programmes’ need for data, similar and parallel data requirements from both the vertical programmes and the health care managers at the MoH).

Furthermore, the findings revealed that some old ways of working, which initially were not visible during the modelling state in the HIS developmental cycle, became visible as the HIS was embedded in the organizational context. Their visibility came in form of contradictions between the old ways of working and the new ways of working. These contradictions were not resolved; rather the old ways of working were inherited by the new activity system. The inherited ways of working are conceptualized using the notion of ‘installed base’ from information infrastructure studies. For example, the installed base of languages (a mix of Kiswahili and English) used in naming the data categories in the paper forms was inherited in the new paper forms. Also the installed based of strong institutionalized practices within the vertical programmes was inherited in the new HIS practices whereby, the vertical programmes managers maintained the production and distribution of the new integrated data collection tools for their specific programmes.
5.1.3. Paper III


Taking an account on the Scandinavian approach of participatory design, the focus in this paper is on mutual learning of local and situated interpretations and implementations of participation in two projects: one in Tanzania-Zanzibar and the other one in Sweden. While I conducted the fieldwork in Zanzibar, my co-authors conducted the fieldwork in Sweden. The fieldwork in Zanzibar is mainly within the referral hospital. During this time, the HISP project in collaboration with the Ministry of Health (MoH) in Zanzibar and other stakeholders started designing and implementing the HIS. The HISP activities were juxtaposed with those from a project in Sweden, which is about e-Government in municipalities. Both projects use participatory design methods and involve the design processes connected to work practices and information technologies (IT) development in the public sector.

The findings are explored in terms of the differences and similarities connected to the two projects. The juxtapose revealed that the perquisites for participation differed between the two projects in terms of location, setting, and technological skills. However, both projects created space for agency for those involved. In the Tanzanian case, due to the nature of health care work practices, in particular, the fact that the hospital studied is a referral hospital, health workers (users and participants in the design and implementation process) were working. In this regard, designers had to follow users in their workplaces. In some cases health workers had to give priority to emergence health care services leading to rescheduling of the planed design activities. Furthermore, with the existing hierarchical boundaries between professionals; both within the individual wards, clinics and the hospital as a whole, key user such as the head of the statistics department played a major role in coordinating activities between designers and other users. This is in contrast to the Swedish case, which took place in a number of municipalities in a low populated region. In this case, participation involved all the units in focus.
5.1.4. Paper IV


The empirical material in this paper builds on my fieldwork within hospitals in Zanzibar. However, the empirical coverage is expanded in this paper as compared to that in Paper III. This was partly due to the HIS design and implementation approach, which started with the referral hospital and scaled down to district hospitals (see Section 2.4.2 in Chapter 2), and partly due to the focus in each of the two papers. The paper is a thorough analysis of agency in the HIS design and implementation process using a different theoretical perspective from CHAT and participatory design approaches discussed in Paper I, II and III respectively. It explores how agency shapes and is shaped by the design and implementation of an IT based IS as well as how the organizational context is intertwined with people’s possibilities to act. The empirical material is analysed through examining the relationship between participants’ actions and the three elements of agency as described by Emirbayer and Mische (1998): iterational, projective and practical evaluative, with a particular attention on the interplay between technology and social on agency enactments.

The findings revealed the design and implementation of HIS as an act of agency, which is simultaneously influenced by the promise of the future (projective), the practical contingencies of the present (practical evaluative) and the inertia of the past (iterational). For example, health workers’ awareness of future consequences of having standardized age categories for all clinics influenced the inclusion of specific age categories in the data collection tools for the hypertension clinic. The need to differentiate between a new and a repeated psychiatric case within the same month, which health workers are doing in their present work practices, influenced the inclusion of repeated cases in the data collection tools for the psychiatric clinic. Fluctuations in diseases, which health workers have been dealing with in their past health care practices, influenced the choice of relevant data categories for the new HIS (both in the paper forms and the DHIS).
The findings also revealed how technological materiality plays a role in changing practices. The focus on technology reflects on different influences from old paper forms as well as on different activities that the DHIS can support. As a technological application, founded on inbuilt as well as user created functionalities, the DHIS played a significant role in meeting the needs of several health care stakeholders as well as transforming practices and relationships among these stakeholders. For example, the DHIS requirements such as the need for naming diagnoses in such a way that they can belong in the same group influenced the separation of combined diagnoses in one of the wards. With the format of the new paper forms and the DHIS, health workers in the wards had to reorganize the register books that are used for daily data recording to facilitate the report preparation process (see Figure 2.8 for the various data collection tools used).

In addition, the findings indicates that to facilitate data reporting through the DHIS it was necessary to have network and internet connectivity within and between the different health care organizational levels. These technologies (DHIS, network and internet) in turn reshaped health workers’ understanding of communication and the way they communicate with each other as well as across organizational levels. While before the existence of these technologies communication depended much on the use of local transport and mobile phones (this was only possible after a wide coverage of mobile phones connectivity), with the DHIS, network and internet health workers could communicate through the use of facilities such as email and Skype.

Furthermore, the findings show how diversity in practices between organizational levels and the health care delivery structure (Figure 2.3 in Chapter 2) influenced the agentic actions which took place during the HIS design and implementation process. For example, the uniqueness of services given influenced the differentiation of data categories between the wards and clinics in the same hospital, and between the referral hospital and district hospitals.

5.2. Summary of the Key Findings

The research aim, the data collection methods, the theoretical concepts of analysis and the key findings described in each paper are presented in Table 5.1.
<table>
<thead>
<tr>
<th>Paper</th>
<th>Aim of the Paper</th>
<th>Research Setting and Methods</th>
<th>Theoretical Concepts</th>
<th>Key Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>To analyse and compare the work practices of a group of health workers in a hospital setting in a developing country context with those of a group of health workers in a hospital setting in a developed country context.</td>
<td>The situatedness of work</td>
<td>Activity Theory (CHAT) - Ethnographic methods</td>
<td>Participants involved in the Participatory Design (PD) project in Tanzania and Sweden. The PD projects were carried out in different hospitals and health care centres in Tanzania and Sweden. The PD projects involved the participation of health workers and other stakeholders in the design and implementation of new health information systems. The PD projects implemented the participatory design principles and methods.</td>
</tr>
<tr>
<td>II</td>
<td>To analyse and compare the work practices of a group of health workers in a hospital setting in a developing country context with those of a group of health workers in a hospital setting in a developed country context.</td>
<td>The situatedness of work</td>
<td>Activity Theory (CHAT) - Ethnographic methods</td>
<td>Participants involved in the Participatory Design (PD) project in Tanzania and Sweden. The PD projects were carried out in different hospitals and health care centres in Tanzania and Sweden. The PD projects involved the participation of health workers and other stakeholders in the design and implementation of new health information systems. The PD projects implemented the participatory design principles and methods.</td>
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</tr>
</tbody>
</table>

Table 5.1: Appended papers: Aim, setting and methods, theoretical concepts and key findings
CHAPTER 6: Discussion – Linkage between the Papers

The aim of this thesis is to explore the interplay between transformation in everyday work practices and IS design and implementation processes in order to increase sensitivity towards context sensitive design. This chapter discusses the empirical findings presented in the previous chapter in relation to the research aim and questions. The theoretical reasoning on the interplay between transformation in everyday work practices and IS design and implementation is anchored with evidence found in specific situations and processes analyzed in the papers appended in this thesis. The discussion entails an endeavour in which transformation in everyday work practices and IS design and implementation process influence each other.

The chapter is divided into four sections. The first section discusses the emerged tensions and how these tensions influenced the transformation in work practices. The second section discusses the interplay between technology materiality, context and the temporal dimension of human agency and how this interplay lead to transformation of work practices. The third section provides an account on participation in systems design processes. With a particular focus on low-income countries, the fourth section discusses the empirical findings in relation to the need for improving IS design and implementation processes within health care organizations.

6.1. Tensions and Transformation in Work Practices

As stated earlier, from a CHAT perspective I view transformation as attempts to reconceptualise, reorganize, and or remediate the HIS activity system in order to resolve its pressing tensions (Engeström, 1999b). During this process, the HIS activity system shifts from one certain historically-constructed activity to another, in which the object of activity is re-conceptualized to embrace a radically wider horizon of possibilities than in the previous mode. In the following, I discuss the revealed tensions in relation to: (i) transformation that occurred due to tensions in routinized work practices, and (ii) transformation that occurred due to tensions during the HIS design and implementation processes. While the former addresses the first research question, the later addressed the second research question posed in this study.
Transformation that Occurred Due to Tensions in Everyday Work Practices

With specific examples from two health care organizations in Tanzania, the empirical findings revealed how different work practices within as well as between activity systems are interrelated (see Figure 6.1). Furthermore, the findings show how these interrelationships characterize the tensions within the HIS activity system (Paper 1 and Paper II). For example, the aspects of work practice involving vertical programmes (Triangle 2), providing health care services (health provision activity system – Triangle 3) and management (the health management activity system – Triangle 4) are all interrelated with the health care data collection, analysis and reporting (HIS activity system – Triangle 1). Transformation in one of these aspects causes tensions within and between other aspects or elements of one or more activity systems (Engeström, 1987; Cole and Engeström, 1993). For instance, a demand on extra data from the higher levels (health management or the vertical programmes activity system), resulted into tensions within the subject (health workers at the health facility) as well as between the tools and the object (tools not able to collect the demanded data) within the HIS activity system.

In this situation, health workers do not stick to routine HIS work practices and, therefore they handle the tensions by deviating from the standard HIS work practices. The situation continues to be a tension especially because the health worker faces similar events in her/his everyday work practices: during daily data collection as well as during report preparation in each quarter (Paper 1). Consequently, handling the emerging tensions becomes part and parcel of health workers’ everyday work practices. As they handle the emerging tensions, health workers transform their work practices and simultaneously change their skills (Triangle 5). For example, when the health worker is asked for a report that s/he cannot prepare with the existing HIS tools, this is a tension. The health worker focuses on the tension and begins to search for tools (e.g. creating a new form for collecting data and preparing the demanded report). The construction of new tools (data collection forms) happens collectively indicating the social scope of and interactive basis of actions.

Likewise, for the health worker at the private health facility with two objects of activity: collective (patients and their illnesses) and individual (income), the findings showed
that the health worker follows the work practice that facilitates the achievement of her/his individual object of work. In this regard, the health worker examines her/his work with regard to the judgement and reasoning required in its accomplishment (Suchman, 1987).

For the smooth and efficient operation of the HIS activity system, all aspects of the other activity systems and their interrelatedness are linked and adapted to each other. By studying these aspects and their interrelatedness, we get an idea of the essential resources for the work being done. Furthermore, health workers’ initiatives for solving the emerging tensions signal needs and potential ways of developing not only the technology but also the conditions of its use. They help IS designers and implementers to understand what aspects of work practices the HIS design and implementation process has to transform in addition to the tool aspect. For example, one of the unintended consequences of the created forms (for collecting the extra demanded data) is the fact that the same data can be collected in different formats from different health facilities. This in turn leads to different patterns of work practices within and between organizational levels and limit other activities. However, the resulting consequences can facilitate further development within a particular IS (Paper II).

The findings thus, emphasise the fundamental role of understanding everyday systemic tensions and emerging solutions for better support of the continued innovation of the system (Engeström, 2000). In addition, through focusing on the historical development of an activity system, such as a working community in which an individual participates, it is possible to give explanations for the motivation required for the tedious and long-term efforts leading to transformations (Miettinen, 1999). It is revealed in this research that health workers faced tensions within their work activities, which were, among others, the lack of tools for data analysis (Paper II). These contradictions entailed transformative interest among health workers and resulted in the design of new paper forms and the DHIS through the HISP project.

The process and transformation that occurred due to tensions in everyday work practices as described above are summarized in Figure 6.1.
Figure 6.1: Transformation of the HIS activity system due to tensions in everyday work practices
Figure 6.1 provides an overview of the HIS activity system (Triangle 1), seen in its network relations with three other activity systems, namely, the health management activity system (Triangle 4), health care provision activity system (Triangle 3) and the activity system of vertical programmes (Triangle 2). Initially, the HIS activity system had a general object (health care data and information). However, as revealed in the empirical findings, the general form of the object of the HIS activity system (as a tool producing activity for the health management and vertical programmes activity systems) did not fulfil the needs for data in the other activity systems. This limitation resulted into tensions within and between activity systems.

In searching for solutions to the emerging tensions, the HIS activity system was transformed (Triangle 5), whereby the object was reconceptualised (i.e. health care data for vertical programmes, for the Ministry of Health, for other health care stakeholders or donor agencies, and for the management of the health facility). The reconceptualisation of the object of the HIS activity system took place in parallel with the remediation of the HIS activity system, whereby additional paper forms were created, excel spreadsheets were used to aid the data collection and report preparation activities, redistribution of responsibilities to cater the emerging activities, and informal change of data collection and reporting routines. Moreover, through engaging in the discussions on how to deal with the emerging demands on data, health workers’ skills were improved. However, the reconceptualisation of the object together with the remediation of the HIS activity system created new tensions (Triangle 5) which formed the basis for further transformations, which took place during the HISP project. These tensions centered on the need for an integrated system (tool) that can facilitate the achievement of the reconceptualised object of activity.

**Transformation that Occurred Due to Tensions during the Health Information System (HIS) Design and Implementation Process**

The analysis of the HISP initiatives illustrated transformation in work practices that occurred due to tensions during the HIS design and implementation process (see Figure 6.2). The revealed tensions centered on two main aspects of the process. The first aspect involves the multivoicedness and complexity in user needs that had to be reflected in the new HIS activity system (Miettinen, 1999; Engeström, 2001). For instance, in some
cases vertical programmes (Triangle 2) and health managers at the MoH (Triangle 4) had different requirements with regard to how the HIS should function (Paper II). Likewise, wards and clinics within the same hospital had different requirements with regard to how the paper forms and the DHIS should be designed (Paper IV). All these tensions were dynamically manifested at certain stages during the design and implementation process. The resolution to these tensions not only marked the shift from one stage of the process to the next, but also catalyzed the expansive development within the HIS activity system.

The second aspect involves tensions between the old HIS activity system (Triangle 1) and the new (in design) HIS activity system (Triangle 5). In other words, while the new HIS activity system (Triangle 5) contributed to the resolution of existed systemic contradictions within and between the interacting activity systems (Triangle 1, 2, 3 and 4), it also created others. For example, the findings showed that the introduction of the DHIS, which was a more advanced tool than the previous paper forms created new tensions between the tools and the subjects (health workers), since health workers did not have the required competences to handle the tool. In this regard, health workers had to be trained on how to use the DHIS and all its functionalities, thus improve their skills on computer use and health care data analysis. As such, the DHIS functioned as an artefact that facilitates the transformation of health workers’ skills, among other things.

In addition, the study indicates that participants do not solely solve the emerging contradictions, but also make sense and reuse some of the different aspects of the old ways of working (the installed base) (Paper II). While this may be considered as the inertia of the installed base in transformation processes, it somehow indicates a sensible compromise between the installed base and the new HIS activity system. This inertia of the installed base was also revealed in the analysis of the HIS design and implementation process through the temporal theory of agency (Paper IV). The analysis revealed dilemmas implicated in the process due to health workers’ needs to preserve old ways of working while responding to the new ways of working as implicated in the HIS design and implementation process. As these dilemmas are resolved over time, through negotiations, participants (HISP and health workers) in the HIS design and implementation process establish new work practices as well as revert to the old ones.
Moreover, the findings indicate that during the design and implementation process, participants do not only participate in solving the emerging contradictions. They also learn more about their work, as they are capable of taking an analytic perspective on their everyday work (Engeström, 1987; 2001). This analysis allows them to explore such aspects of their everyday work that have previously remained invisible due to their unfamiliarity or taken-for grantedness (Karasti, 2003).

The process and transformation that occurred due to tensions during the HIS design and implementation process as described above are summarized in Figure 6.2. The figure describes the HIS design and implementation as a process of solving tensions within and between the elements of the HIS activity system (Triangle 1) as well as between the HIS activity system and other activity systems: the health management activity system (Triangle 4), health care provision activity system (Triangle 3) and the activity system of vertical programmes (Triangle 2). Moreover, the figure indicates the existence of systemic tensions between the old HIS activity system (Triangle 1) and the HIS activity system in design (Triangle 5). These tensions centres on the emerging new HIS activity system and the way it differs from the way the work is being done or was in the past. In resolving the emerging tensions the HIS activity system is transformed into a new activity system (Triangle 6) whereby the object of work is reconceptualised (e.g. health care data – integrated and comprehensive). Moreover, the HIS work activity system is re-mediated: standardized paper forms and the DHIS are designed and implemented, new rules and procedures to guide the data collection and reporting are created (e.g. monthly reporting, direct reporting from the district level to the MoH, sharing of data between the MoH and vertical programmes), the division of labour among health workers and between organizational levels (e.g. the MoH in collaboration with the vertical programmes are responsible for the supply of data collection tools to the lower levels, a specific health worker appointed to be responsible for data collection, reporting and storage at the district level).
Figure 6.2: Transformation of the HIS activity system during the design and implementation process.
6.2. Participation and How to Participate

While it is commonly acknowledged that participatory design and ethnographic studies provide alternative ways for making work accountable in design (e.g. Bjerknes and Bratteteig, 1995; Kensing and Blomberg, 1998), participatory design approaches have not been a tradition in the context of low-income countries. In this regard, a number of studies have argued for the need of and how to contextualize these approaches in low-income countries (Madon and Sahay, 2001; Nhampossa et al., 2004; Puri et al., 2004; Kiura, 2006). This is due to the diversity in socio-economic and political situations between low-income countries and western countries from which participatory design approaches originated (Puri et al., 2004).

In the context of low-income countries the challenge is on how to build on participatory design approaches and develop methods that are inclusive and bring forward the skills and knowledge of workers, which as well permit and enable them to collaboratively define and design the technology implemented into their work practice (Puri et al., 2004). This is inline with the findings in this study, which revealed that there are no universal answers to the ongoing discussion about the relationship between designers and users in participatory design approaches (Paper III). Participation and how to participate in design and implementation processes has to be negotiated and adapted to local settings. For example, the participatory design process studied in this thesis revealed that due to the nature of the health care work practices and users’ (health workers) skills and experience on IT, designers’ knowledge and skills seemed to dominate. Likewise, the users were not of a uniform group: some dominated more than others did.

However, in addition to user needs that are expressed through user participation in design (Paper III), the findings in this thesis suggest that users’ tensions in actual work practices need to be seen as highly important formation for designers and implementers of new IT/IS (Paper II). Merely acquiring information about individual user’s needs and opinions is not enough for understanding the emerging needs in a collective HIS activity system. Rather, analysis of the contradictions in the activity systems is needed to capture the complex and multivoiced character of user needs (Engeström, 1987; 2001). This analysis is a continuous activity throughout the IT/IS
design and implementation process. Thus, a combination of participatory design and CHAT approaches helps to analyse both the needs of individual users or user groups and a socially structured activity system. In this regard, design is treated as a cycle of inquiry in which user needs are revealed by analyzing tensions and opportunities in everyday activities.

The multivoicedness found in this research was for example, expressed through different needs and interests on the part of vertical programmes and the Ministry of Health (MoH) with regard to the contents and structure of the HIS. These voices helped in directing attention to the different actors’ varying interests, motives, and tools during the design and implementation of the new HIS. However, addressing the various voices is not a clear-cut process. I have showed how negotiations played a major role in achieving a common understanding and solution to the emerging contradictions between various voices (Paper II and IV).

Resolving the emerging contradictions helped participants to reflect on and learn more about their work practices. The learning that took place is more than mutual learning that is practiced in participatory design approaches. Mutual learning is based on the idea that designers learn about actual context of IT/IS use from users, and users in turn acquire knowledge of possible technological options from designers (Trigg et al., 1991; Bratteteig, 2004). In this regard, it does not support the analysis and learning more about work practices than what is already known (Karasti, 2001). The emerging contradictions during the design and implementation process allow users and designers to become informed of possibilities and restrictions of the technology being designed for their work. Karasti (2001, p. 106-107) articulates similar issues on what she refers to as the dimension of analytic distance in the analysis of work. Analytic distance, she argues, "enhances possibilities for multidimensional explorations of work practice understandings which, in turn, are extended to more informed design considerations."

However, Karasti’s suggested approach on analytic distance is different from my findings in the sense that, the approach requires a mirror of actual work practices represented in an accessible form, which practitioners can confront outside their everyday settings to be able to concentrate on analysing and reflecting. This may be difficult for practitioners with busy work practices like the health care workers studied.
in this thesis. My use of the expansive cycle from Developmental Work Research (DWR) approach showed that the analysis and reflection of work practices is a continuous process, which does not need to be distanced from the actual work practices (Paper II). In this regard, the process of transforming work practices is brought closer to the daily activities while still keeping a reflective distance (Engeström and Escalante, 1996).

6.3. The Interplay between Technology Materiality, Context and the Temporal Dimensions of Human Agency

The findings of this research revealed situations in which the interplay between technology materiality, context and human agency plays a role in transforming the work practices. As discussed in the previous sections, CHAT helped to reveal agency as the need and ability of participants to act in response to the emerging contradictions (Kaptelinin and Nardi, 2006; Yamazumi, 2007). In this regard, transformation occurred as participants engaged in resolving the emerging contradictions (Paper I and II). In addition to locating agency in the ways in which actors respond to contradictions, my research revealed how actors critically reinterpret their orientation and actions towards the promise of the future, the inertia of the past, the practical contingencies of the present (Emirbayer and Mische, 1998), technological materiality, and the context in which the HIS design and implementation process took place (Paper IV). The inertia of the past is also revealed in my analysis of the HIS design and implementation process in which some of the emerged contradictions were not resolved into new ways of working (Paper II).

For example, health workers had previously worked with several separate systems of data collection and reporting, which guided and disciplined their work practices. Thus, during the HIS design and implementation process, they had to align the material and disciplinary agency of previous systems with the projected view of the new HIS as a single and integrative system for all health care stakeholders. Likewise, the DHIS functionalities and the type of activities that it can support played a significant role of changing practices of different health care stakeholders as well as the relationships among them.
Moreover, the findings showed that the balance between the continuance of past practices and accommodation of the present and future demands was achieved through negotiations (Paper IV). These negotiations based on the needs for data from different health care stakeholders, the DHIS’s functionalities, and the need for an integrated HIS among other factors. The resulting content and structure of the HIS is understood as resolutions to agency dilemmas in which temporal contradictions are reconciled.

This role of negotiations was also revealed in addressing the multivoicedness character of contradictions (Miettinen, 1999; Engeström, 2001) in which different health care stakeholders’ information requirements were negotiated in order to come up with an integrated content and structure of the HIS (Paper II). Emirbayer and Mische (1998) argues that, inherent in all humans is the capacity to appropriate, reproduce, and, potentially, to innovate upon received cultural categories and conditions of action in accordance with their personal and collective ideas, interests, and commitments.

6.4. **HIS Design and Implementation: Insights from the Empirical Findings**

From the empirical findings (Paper I, II, II and IV), it is clear that, in Tanzania, like in many low-income countries, competing stakeholder demands, poor resources, and low computers literacy among other factors are major challenges on IS design and implementation within health care organizations (Moahi, 1999; Alvarez, 2004; Kimaro and Nhampossa, 2005). As health care organizations continue to invest heavily in information technology (IT) and IS, the need to proactively address these challenges is rising (Heeks, 2006). The main insights on dealing with these challenges are implicitly discussed in the previous sections in this chapter. In this section, a more detailed and open discussion regarding the empirical findings and their implications for HIS design and implementation in a low-income context is provided.

**Competing Stakeholders Demands**

Studies have indicated that donor funded vertical programmes are largely responsible for the fragmentation of HISs within health care organizations in low-income countries (Chilundo, 2004). This is similar to the findings in this study where health workers
have to deal with frequent changes in data requirements from vertical programmes (Paper I and IV). One-way to instil the design, implementation and use of an integrated HIS is to involve all health care stakeholders in determining what data is needed and how it will be used (Byrne and Sahay, 2006). This strategy was also applied in the HIS design and implementation process described in this study (Paper II, III and IV). However, as indicated in the findings in this study, during the HIS implementation process, vertical programme managers expressed their fear of losing the degree of information details that they had through their separate systems as well as the sustainability of the designed HIS due to the MoH’s limited financial capacity in producing the data collection tools (Paper IV). Moreover, the findings indicated that health workers at the health facility level continued to use the old forms from the vertical programmes since the specific vertical programme managers had not told them to stop.

In this regard, the findings indicates that the involvement of vertical programmes in determining their data requirements alone is likely to be insufficient unless accompanied by sustained support to the HIS operation coupled with greater vertical programmes’ accountability and allocation of responsibilities. The role of vertical programmes should not end on articulating their data needs for the HIS integration purposes. It should also include their involvement in various HIS responsibilities such as the introduction of paper forms as it was indicated in this study (Paper IV). Moreover, another insight from the empirical findings of this thesis is that, in building the case for a single, unified information system, much greater advocacy is required at all levels of the health care organization as well as to all health care stakeholders.

In addition to the challenges of establishing an integrated HIS that addresses the needs of the MoH and all the donor funded vertical programmes, the findings indicates that there can also be substantial challenges in persuading private health care providers to adopt the same HIS as the one being used in the public sector. In many countries, private health care provision can account for the large majority of health care provided (Palmer et al., 2003) so that data from private health facilities is crucial for having a holistic picture of the health of the population. However, the findings indicate that when using the same HIS as the one being used in the public sector, private health care providers report less compared to the actual number of patients attended (Paper I). In
some cases this is perceived as the reluctance of private health care providers to integrate into the national HIS because of using their own established systems already (Lippeveld, 2000). In addition, the findings in this study indicate that private health care providers report less because of their fear in paying large taxes due to the number of activities that they have conducted. A key insight from these findings is that, rather than using the number of patients attended in determining the amount of tax that a private health care provider should pay to the government other measures can be taken. In this regard, the health care providers can report the actual number of patients attended without fear of an increase in the amount of tax they have to pay to the government.

**Poor Resources**

The finding in this study indicates that the HIS in resource poor countries such as Tanzania have been and is still a hybrid system of both paper based and computer based systems (Paper I, II, II and IV). While a computer database (DHIS) could be implemented at the district level, since most districts have electricity, paper registers and forms are being used at the health facility level, which are in most cases located in remote rural areas without electricity. Within this structure, the data to be entered and analysed through the computer database at the district level depends on the quality of data from the paper registers and forms that are being used at the health facility level. In this regard, the DHIS at the district office which has electricity serves as a hub where data from the health facilities can be entered, analysed and shared among the health care stakeholders. A key implication of this structure is the need for strengthening the paper based part of the HIS since the quality and usefulness of data in the DHIS depends on the way data are being recorded and transmitted from the paper registers and forms.

Furthermore, designing and implementing a computer database such as the DHIS in this study presented challenges considering frequent power shortages and low computer literacy among other features of a low-income country context such as Tanzania. However, in the long term this implementation may generate benefits, specifically related to the excessive and competing data demands that arise from the multiple vertical programmes. With the DHIS software it is possible to automatically
generate diverse reports, which can be tailored to fit with each health programme's format requirements with less work (Paper II and IV).

Although the introduction of a fully computer based HIS may seem far off in many health care organizations in a low-income context such as Tanzania they are being introduced rapidly in others and there is no doubt that the future of health information management lies with automation and the automatic transmission of information required for patient management at all levels of the health care organization (WHO, 2006). This in turn requires putting more efforts in establishing ICTs related infrastructures such as electricity and possibly establishing the use of other means of power such as solar power, which is energy from the light of the sun.

Moreover, while there are many attempts concerning the design, development and implementation of locally based HISs in low-income countries, existing HISs remain locally unsustainable due to poor resources (Kimaro, 2006). In a challenging social setting with limited resources, sharing of HIS responsibilities among the MoH and donor funded vertical programmes can help in facilitating and sustaining HIS design, implementation and use (Paper II). For example, sharing the production of paper forms for collecting health care data related to the needs of specific vertical programmes as it was found in this study.

**Low Computer Literacy**

The findings in this study indicates that health care workers are extremely hard working, deeply committed to provide health care services as well as meeting the competing stakeholders demands on health care data (Paper I and II). It is their initiative and ability to improvise that enables them to complete their required tasks even under conditions of extremely scarce resources and overwork. Similar findings were revealed by Mosse (2005) in his study on challenges related to communication practices (processes that surround the construction, collection, analysis and transmission of routine health data within and across the various levels of the health administration hierarchy) in Mozambique and how these practices shape the introduction of computer-based HIS. The findings in this study revealed the voices of actual system users and their contribution to the IS design and implementation process.
(Paper II, II and IV). Despite the fact that users in this study did not have technical knowledge, their contribution in the HIS design and implementation process arose from their everyday knowledge in terms of procedures and health care services being provided. In this regard, the context of HIS design and implementation in a context where users have low computer literacy such as in Tanzania can be seen as encapsulating everyday modes of communicating and using existing and relevant experience-based knowledge.

Furthermore, the findings revealed how the comprehension and exposure to ICTs which health workers received through the HIS design and implementation process played a significant role in changing practices of different health care workers and stakeholders as well as the relationship between them. Furthermore, the fact that most health workers were computer illiterate, the use of DHIS opened possibilities and motivation for health workers to learn how to use computers (Paper II and IV).

Training is one of the key factors in building capacity among health workers within the HISP project (Paper II, III and IV). However, training should not only focus on the use of the HIS being designed and implemented, rather the focus should be on establishing locally based long term training programmes such as the HIS courses at the local universities as it was the case in this study (Braa et al., 2004). Rather than concentrating too much on how to work with the technology and the HIS being designed and implemented, long term training programmes can be used to put emphasis on why the technology and the system should be used.
CHAPTER 7: Contributions and Conclusions

This chapter summarizes the study presented in this thesis. The chapter is divided into three sections. The first section presents the theoretical and practical contributions. The second section outlines the limitations of the study and thereby envisions future areas of research. The chapter ends by providing concluding remarks.

7.1. Contributions

7.1.1 Theoretical Contributions

The basis for my theoretical contributions is a diversity of theoretical concepts and their combination in analysing transformation in work practices. I argue in this thesis that as the activity theoretical approach to IS research continues to be developed and applied, it could potentially benefit from contributions from a wider range of theoretical perspectives. The conceptual framework suggested in this thesis contributes to existing activity theoretical approaches and methodologies to the study of work practices and IS research by emphasizing the following aspects:

i) Situatedness of work practices as a way to understand the tensions between the needs of an individual as part of different collective activity systems.

ii) Considering the practical contingencies affecting action in the present.

iii) Emphasizing aspects of work practices that are taken from one activity system to another during its expansive development.

Situatedness of Work Practices as a Way to Understand the Tensions between the Needs of an Individual as Part of Different Collective Activity Systems

Cultural Historical Activity Theory (CHAT), with its emphasis on the need to look at real activities in real situations helps in studying the context in which users work for the purpose of systems design. However, the CHAT approach in general and the developmental work research in particular, bind the individual, collective and
technological aspects of work together. Based on the empirical findings and analysis I argued in this thesis that, the needs of an individual as part of different activity systems might differ and cause tensions within and between activity systems. In this situation, the individual is likely to follow the work practices that facilitate the achievement of her/his individual object of work.

By addressing the interrelations between the needs of individuals and the multiple activity systems (or multiple objects of activity) in which they take part, I contribute to the understanding of the dynamics in work practices that requires a substantial adaptation to individual objects of work. In this analysis, work is examined with regard to the judgement and reasoning required in its accomplishment. Such analysis helps to understand and describe the actual performance of work applied to certain specific object of work.

**Considering the Practical Contingencies Affecting Action in the Present**

While agentic actions are central to the analysis of transformation occurring due to resolving emerging contradictions in an activity system, activity theoretical approaches are limited in the analysis of how actors shape their own responsiveness to emerging contradictions. In activity theoretical approaches, actors act because they need to (e.g. responding to the emerging contradictions) and they have the ability to act. I argue in this thesis that, in addition to conceptualizing agency as the need and ability to act, it is crucial to understand the conflicting practical contingencies which shapes agents’ responsiveness to situations they encounter in their everyday work practices as well as when new technologies and IS are introduced. Such an understanding offers a more theoretical explanation for the choices that agents make when confronted with the need to act and thus facilitate the negotiation of a better and common meaning.

I have showed that while agents may need and have the ability to act, their actions are influenced and shaped by their temporal orientations: past experiences, imagination of new possibilities and the dilemmas they face in the present as well as technological features in design and the social context of action. The incorporation of the role of technology materiality in influencing and shaping agents’ actions offers a distinct contribution to CHAT approaches. It helps to exemplify the role of technology in
shaping actors responsiveness to the emerging contradictions. This account recognizes that although in different degrees, both the humans and technology play a role in transforming work practices.

**Emphasizing Aspects of Work Practices That are Taken From One Activity System to Another during Its Expansive Cycle of Development**

Historicity is a concept fundamental to describing an evolving activity system within the CHAT perspectives. An activity system is seen as a multivoicedness formation whereby an expansive cycle of transformation is a reorchestration of those voices, of different viewpoints and approaches of the various participants. Historicity in this perspective means identifying the past cycles of the activity system. However, the analysis of the HIS developmental cycle showed that historicity, combined with the possibility of expansive transformation, leads to a situation where you need a way of describing the ongoing social reproduction of the past activity and thus how to live with contradictions within and between activity systems. I argue in this thesis that the notion of installed base from studies of information infrastructure helps to have an explicit explanation of what and why certain aspects of work practices get inherited from one activity system to another. In this regard, a generalized strategy for studying transformation in work practices needs to incorporate both these themes.

### 7.1.2 Practical Contributions

This study took place in the health care setting, which is characterized by dynamics in work practices. In this regard, its practical implications are more specific to the health care settings. However, I do see the potential of its applicability also in other practical settings where work is based on commonly shared routines and procedures involving practices that are not easily made visible. There are two key practical contributions arising from my research:

i) Studying current work practices with change thinking

ii) Contextualization of participatory design approaches in non western countries
Studying Current Work Practices with Change Thinking

The idea of intertwining work and change in a continuum of transformation is not common, not even in the integration of work practice and system design (Karasti, 2001, p. 114). I have showed how the activity theoretical analysis of transformation in work practices explicitly intertwines both current work practice and change thinking by highlighting tensions faced by IT/IS users in their everyday work practices and how the participants involved attempt to deal with the emerging tensions. This capacity to deal with the emerging tensions as well as shaping the HIS design and implementation process may be limited due to users’ knowledge and available resources, but it nevertheless exists and can be potentially strengthened to facilitate the design and implementation of more context sensitive IS. While the users did not have technical knowledge, their non-technical knowledge, in terms of procedures and health care services being provided, proved vital for the HIS design and implementation process. The focus here is on understanding HIS design and implementation process as a motivational and transformational practical activity performed for and through the collective efforts of expert designers and users who are seen as local designers with competency in their everyday work practices.

Moreover, I have showed that it is important that not only user’s agency is identified and considered, but also, the reasons behind their actions should be taken into consideration for facilitating the emergence of a shared meaning. The analysis proved useful for revealing the shortcomings of the existed HIS and the requirements for the new HIS.

In addition, the thesis has analysed transformation efforts involving multiple activity systems. The analysis explored the complex relationships between these activity systems that can not be fully understood by considering the involved activity systems individually. The analysis of multiple interacting activity systems is particularly important in systemic transformation where for example, one partner activity system introduces tools that are intended to mediate the activity of the others or facilitate the production of the element(s) for the other activity systems, as in the study reported in this thesis.
Contextualization of Participatory Design Approaches

The experiences from the participatory design approaches analysed in this research have resonance with previous studies and arguments, particularly on the fact that participation and how to participate has to be negotiated and adapted to the local setting. However, more contributions from my research are derived from the theoretical framework and the analysis of the empirical material. While practitioners immersed in the everyday work practices can verbalize a part of their ordinary work practices during participatory design, another part remains unarticulated because these aspects are either too mundane or taken-for-granted for recognition. To gain access to this invisible or tacit knowledge that nevertheless is integral to the accomplishment of everyday work, participants in the IT/IS design processes have to pay attention to the emerging contradictions within a work activity. The CHAT and DWR approach applied in this study emphasize that analysis of user requirements should be an ongoing process throughout the IS design and implementation process whereby understanding emerging contradiction help designers to understand not only what users talk about but also what can be found in silence.

7.2. Future Research

The research presented in this thesis has revealed several issues with regard to the interplay between transformation in work practices and IS design and implementation processes. Some of these issues are worth for further exploration as discussed in this section.

The CHAT perspective adopted in this study emphasizes examining a historically evolving activity system as it is seen in its network relations to other activity systems (Engeström, 2000). These network relations were partly addressed in this thesis through revealing the tensions due to the interactions between the HIS activity system, the health care provision activity system, the health management activity system and the activity systems of vertical programmes, and partly through revealing the tensions that health workers at the private health facilities face due to being part of two collective activity systems: health care and the tax organizations.
However, there are several network relations that when examined can further reveal the resulting tensions and their impact on the HIS activity system which were not examined in this thesis. This limitation is partly due to the research design, which provided a retrospective analysis of work practices within a single organization and partly due to the fact that it is not possible to cover everything in a doctoral fieldwork. In this regard, interesting opportunities for more research involve a detailed analysis of the interactions between:

i) The HIS activity system and the medical training activity system.

ii) The health care organization and other organizations

7.3. Concluding Remarks

The basic argument of this thesis is that studies on work practices are commonly concerned with exploring routinized work practices for the purpose of future technology design. In this regard they are limited in exploring the element of transformation that exists in work practices. This thesis has presented a theoretically and empirically informed interpretive and critical study on the interplay between transformation in everyday work practices and information systems (IS) design and implementation processes. The study is empirically based on everyday health care work practices and the health information systems (HIS) design and implementation processes under the Health Information Systems Programme (HISP) initiatives within two health care organizations in Tanzania: Mainland and Zanzibar.

The theoretical perspective, built by complementing Cultural Historical Activity Theory (CHAT) perspectives with situated action, the temporal view of human agency and the concept of installed base from information infrastructure studies, has explored transformation in work practices in a way that does not privilege the deterministic ideas. Current work practices were analyzed to determine the inherent transformation occurring due to resolving contradictions: within and between the elements of the HIS activity systems, between the HIS activity system and other activity systems within and outside the health care organization, and between the existing work practices and new practices as a result of the HIS design and implementation process.

In summary, I argue that by exploring the interplay between transformation in work practices and IS design and implementation processes, this thesis contributes to
context sensitive design and implementation of IS in both developed and low-income countries with a particular focus on health care organizations. Such a contribution is central to addressing the slow and problematic processes of IS implementation in health care organizations especially those in low-income countries like Tanzania.
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APPENDIXES
APPENDIXES I

The situatedness of work practices and organizational culture: implications for information systems innovation uptake

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Abstract
This paper addresses work practices and organizational culture as situated actions and the implications for information systems innovation uptake. It reports research being conducted in Tanzania that brings an ethnographic research approach to understanding relations between local health care practices and health information systems development, by asking how health workers’ practices and everyday actions are influenced by the context of their specific situation. The research is being conducted in the context of a globally distributed open source software project to introduce and enhance health information systems in developing countries. Drawing on cultural historical activity theory, the study highlights the need for understanding each information system user’s and each organization’s specific and detailed work processes, and how situational and organizational factors may come together with the health information systems innovation processes in meeting the challenges discussed. In order to establish fully the potential of activity theory to innovation processes, situatedness of work practices focusing on the organization context is emphasized.

Introduction
In Tanzania, like in many other developing countries, there have been attempts to develop and implement health information systems (HIS) as part of a globally distributed open source software project known as the Health Information Systems Programme (HISP). HISP aims at strengthening and further developing HIS in public health in an expanding network of developing countries including South Africa, Mozambique, Tanzania, Malawi, India, Ethiopia, Mali, Botswana, Nigeria, and Vietnam (see Braa and Hedberg, 2002; Braa et al., 2004; Braa and Muquinge, 2007; www.hisp.info). These HIS innovation processes, however, do not take place in a vacuum but within the context of the organizational setting. The work practices, which involve the collection, storage, analysis, and transmission of routine health data throughout the health care administrative hierarchy, are influenced by the context of workers’ specific situations. The work practices and existing health workers’ actions are often in tension with situational, individual, and organizational aspects of work. Organizational context in particular settings should be explored in depth to understand their effects on information systems (IS) innovation processes (Kuutti, 1991; Grudin, 1996; Bednar and Welch, 2007).

The focus in this paper is on the situatedness of work practices and organizational culture as key sites for understanding the cultural–historical constitution of coexisting modes of practice and potentials for change. The setting is the Tanzanian HIS, comprising the health facility level, district level, regional level, and the national level. The focus in this paper is on the health facility and district levels because it is at these levels where the health care work practices can be observed. The other levels (regional and national level) are more administrative in nature. The aim is to understand how health workers’ working practices and
everyday actions are influenced by the context of their specific situations, including the interaction between multiple organizational contexts.

Cultural historical activity theory (CHAT) provides a potentially useful framework for understanding the mutual shaping of context and work practice (Kuutti, 1995; Crawford and Hasan, 2006). With CHAT, a historically developed activity system is seen to have an objective that is the object of work. However, CHAT’s ability to address the situated nature of work is limited. This is of obvious significance in work practices characterized by a variety of objects of work (Iivari and Linger, 1999), such as health care work practices. Thus, in analysing the situatedness of work practices and organizational culture, the CHAT framework is complemented with situated action perspectives (see below).

The rest of the paper is organized as follows: the next section outlines a theoretical framework based on CHAT. The subsequent section provides the details on the context, setting, and research methods. Basing on the empirical work in Tanzania, the further section describes the work practices and organizational culture that surround the HIS. The penultimate section presents an analysis of the empirical data based on the key concepts drawn from CHAT and situated action perspectives. Finally, in the last section, concluding remarks arising from the study are presented.

**Cultural historical activity theory**

Originating in the former Soviet Union (Leont’ev, 1978; Vygotsky, 1978), CHAT is a framework for studying different forms of human praxis as developmental processes with both the individual and social level interlinked (Kuutti and Arvonen, 1992; Engeström, 1999b). While individual actions can only be understood through the activity of which they are a part, activities are culturally and historically created and recreated. Human activities reflect real-life phenomena and not just theoretical constructs (Bardram, 1997; Blackler et al., 2000).

CHAT interprets work practices as activities and it explores the links between event and context (Bratteteig and Gregory, 1999). Moreover, it interprets social structures as both the production of human activities and the context for them. Human work activity has the following characteristics: it is directed towards a material or ideal object that distinguishes one activity from another, it is mediated by artefacts, and it is social within a culture. By acting in the world, human beings meet the objective world, which is historically created and recreated. Human activities reflect real-life phenomena and not just theoretical constructs.

Engeström (1999a) extended CHAT by developing an activity system model that adds the notions of rules and procedures, division of labour, and community to describe the social context in which the collective activities are carried out (Figure 1). Rules regulate actions and interactions within an activity. The division of labour shows how tasks are divided horizontally and vertically between subjects, that is, at the same level as well as on different levels. The community comprises one person or a group of people who share the objectives with the subjects (e.g., patients attending the health facility).

Activities are influenced both by other activities and environmental changes, which may cause difficulties or tensions. In turn these tensions cause people to change their activities and simultaneously change themselves (Engeström, 1987, 1999a). Rather than analysing an activity system as a static picture of reality, the developments and tensions within the activity system need to be described and analysed. Thus, CHAT avoids treating individuals as if they can be understood in isolation from their contexts, and the contexts as if they exist in isolation from individuals. Hence, in CHAT, ‘it is the doing of the activity in a rich social matrix of people and artifacts that grounds analysis’ (Kaptelinin and Nardi, 2006: 9).

CHAT has been widely applied in education, linguistic, anthropology, and cultural research. It was first presented as a research approach to the study of IS and related disciplines at the IFIP WG 8.2 conference in 1991 (Mursu et al., 2007). Since then, CHAT has been applied to research on human–computer interaction (see Kaptelinin, 1992, 1996; Kuutti, 1995; Nardi, 1996a; Kaptelinin and Nardi, 2006), computer-supported cooperative work (see Bardram, 1997; Mwanza, 2003), and IS (see Kuutti, 1991; Korpela et al., 2001; Crawford and Hasan, 2006). Based on the fact that the purpose of IS is to facilitate work activities, Kuutti (1991) suggested that the object of analysis in IS should be (work) activity systems in all their aspects and dynamics. Similarly, the complex phenomena associated with socio-technical systems that have emerged in the IS field are prime targets for research using CHAT as an underlying framework (Crawford and Hasan, 2006).

In summary, CHAT helps to analyse and describe the work people are doing, how they are doing the work and with whom, and how collective learning may occur, resulting in a description which provides a picture of a particular organizational culture. Furthermore, CHAT offers a dialectical approach, open to change and recognition of the emergence of mundane innovation in everyday practice, with emphasis on the social and holistic nature of individual and collective learning and human development. It is on this basis that CHAT is used for analysing and discussing the local challenges in IS innovation uptake, focusing on work practices and organizational culture as situated actions.

However, Iivari and Linger (1999) argue that CHAT assumes that work is continuous or fairly repetitive without any substantial adaptation to individual objects of work. It
‘does not make a clear distinction between activity addressing a type of objects of work (e.g., patients) and activity addressing a single object of work (a particular patient)’ (Iivari and Linger, 1999: 4). Influenced by the situated action approach, they argue that in work practices characterized by a variety of objects of work, a single actor may be required to work on several objects of work at the same time.

CHAT and situated action

The situated action approach emphasizes the interrelationship between an action and its context of performance; it emphasizes the knowledgability of actors and how they use common sense practices/procedures to produce, analyse, and make sense of one another’s actions and their local or situated circumstances (Doerry, 1995; Suchman, 1995). It is not a merely claim that context is important, but what constitutes the context and how an actor’s perceptions of the situation and specific actions are continually working together (Clancey, 1993).

Situated action has been used as part of human–computer interaction studies (see, e.g., Suchman, 1987; Bardram, 1997). These studies have shown that information technology (IT) and IS use is not a technical input–output relation between a person and the technology, that a much richer understanding of the user’s situation is needed for IS innovation uptake. However, it is unclear how to formulate that understanding in a way that is not purely ad hoc (Nardi, 1996b). Activities within an organization are reconstructed ex post facto and objectified by actors so that they can be used in future. Thus, in addition to the situated action approach, CHAT offers a set of perspectives on human activity and a set of concepts for describing that activity.

Organizational culture

With the widespread diffusion of IT and IS applications, we are increasingly witnessing the same technology being used in many different cultures. The notion of culture has multiple definitions. Most definitions see culture as consisting of several elements of which some are implicit and others are explicit (Groeschl and Doherty, 2000). In this paper, culture is seen as a system of shared meaning and expectations held and shared by members of a group (Giddens, 1993; Hofstede and Hofstede, 2004). According to Hofstede (1991), there are three main factors that at least determine the behaviour of a person in the workplace: national culture, occupational culture, and organizational culture.

Organizational culture, the focus of this paper, is defined by Schein (1992) as a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration. Problems related to external adaptation concern views of an organization’s activities can take place. Although the use of an organizational culture perspective for IS research has been discussed to a certain degree, there is still much to learn from studying organizational cultures. A situated action perspective, very broadly defined, constitutes a promising vehicle for such research.

Context, setting, and methods

The study was inspired by an ethnographic methodological approach (Aunger, 1995; Hardon et al., 2001) with the use of interviews, participant observation, document analysis, informal talks, and discussion during the training and analysis of the information flows within the HIS in Tanzania. These research methods provided details and descriptions of health facility situations, events, interactions, and observable behaviours for understanding how health workers’ practices and everyday actions are influenced by the context of their situation. The author was directly engaged in the health facilities and thus played the role of participant observer (for instance, assisting nurses with weighing children and recording their weights). She is a member of the Tanzanian HISP team, and thus has played a central role in collaboration with health workers at all levels in the national health care system. Her role in the HISP team involved organizing on-site and off-site training on basic computer use and data handling skills for health workers at all levels of the health care organization. The empirical material presented in this paper was collected during the periods from January to July 2005, and from February to April 2006.

In-depth, semi-structured interviews were conducted with 32 members of the health sector in two health care districts of the Coast region. The interviewees were the people in charge of the health facility, the district information officers (DIOs), members of the council health management team (CHMT), the regional information officer, and the HIS people at the Ministry of Health (MoH). Each interview was approximately 1 h long and was conducted in the local language, Kiswahili. Each interview
started by introducing the purpose of the interview along with reassurance about confidentiality and the right of the interviewee to decline to answer any question to which s/he would prefer not to respond. After each interview, the interviewees were asked to provide a list of potential additional interviewees as well as to provide documents of use to the study. Notes were taken during the interview in a summary form and the summaries were filled out immediately at the end of the day. The interviews took place within the health facility surroundings, mostly in health workers’ offices as they needed to continue their daily health care activities.

Participant observation and informal talks (both during the interviews and training sessions) were used to gather an impression of the working conditions in the health facilities and to understand health workers’ working practices in depth and detail. Approximately, 20–30 h a week throughout the research period were spent doing the observations in different health facilities while documenting the observations in field notes. The documents analysed include health performance reports at health facilities and the district level, the district plan reports and HIS implementation plan, the HIS guideline manual, and data documentation. The legibility of patients’ records was also analysed from various recording paper forms.

Understanding from these various sources of research data were developed following the principle of triangulation (see Patton, 2002). Activity system elements have been used to analyse and classify the empirical material for each element, the relationships between the elements, and the tensions between the elements.

The HIS in Tanzania

Tanzania has achieved considerable expansion of health services since its independence in 1961. The health sector reforms initiated in 1993 have made some progress in improving health care services and resources situation throughout the country. However, there are problems with limited capacities for generating reliable data, analysis, storage, retrieval, dissemination, and use. As a consequence, decision-making in the health care system is not generally evidence-based (WHO, 2002).

The current routine HIS in Tanzania is known by the acronym MTUHA, covering both government, private, and NGO (non-governmental) health facilities. MTUHA’s administration and reporting organization hierarchy has four levels: health facility level, district level, regional level, and national level (see Figure 2). The information within MTUHA is based on data collected at the health facility. The district level, being the main operational unit within the organization hierarchy, is responsible for planning, managing, and supervising all health facilities and health care programmes.

**MTUHA organizational context and working practices**

At the health facility, which is the origin of most routine health data for MTUHA, health workers collect data routinely on outpatients (OPD), inpatients, and maternal and child health (MCH). However, additional data are obtained from workers in the surrounding community: village health workers, traditional birth attendants, community-based distributors for contraceptives, and school visits. The data collection and processing consist of a set of MTUHA paper forms, register books (12 in number), and tally sheets. In addition to the MTUHA system, there are different forms from donor-funded vertical programmes, such as tuberculosis, malaria, and immunization. Most forms are written in a mix of Kiswahili and English. Reports are then prepared on weekly (reports on specified diseases), quarterly (a standard comprehensive report), and yearly basis and sent to the district medical officer (DMO) for details, see Rubona, 2001; Lungo, 2003; Mukama, 2003). Data handling involves a group of health workers from different sections of the health facility who have been given responsibility for MTUHA. The group consists of the MCH coordinator, the OPD coordinator, etc., depending on the number of sections (services) available at the particular health facility.

At the district level, reports from the health facilities are aggregated into an overall district quarterly report and sent to the office of the regional medical officer. One copy of the district quarterly report is also sent directly to the primary health care secretariat, which is a section in the local government authority responsible for managing health centres, dispensaries, and village health posts. Since the beginning of MTUHA, the preparation of an overall district report was done manually and involves a group of health workers who work together as a team. The team is composed of different coordinators for different health

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**Figure 2** MTUHA administration and reporting organization hierarchy.
care service sections. At the regional and national levels, data processing is done with the help of a MTUHA computer software package. The regional level is responsible for sending quarterly reports to the national level (MoH) for further processing, based on further aggregation of the health data from the regional districts. The overall information flows within the MTUHA system are summarized in Figure 2.

**HISP in Tanzania**

In collaboration with the HIS unit at the MoH, the HISP started its pilot activities in two health districts in the Coast region in July 2002. The activities included implementation of the District Health Information Software (DHIS), as well as conducting research on data collection, information flow, and use (see Kimaro and Nhampossa, 2005; Lungo, 2005). At the time this paper was written, HISP was still conducting pilot studies in the Coast region. Since 2004 HISP has been designing and implementing the HIS for Zanzibar, which is a political entity of the United Republic of Tanzania.

**Contextual influences and resulting tensions**

This section presents the health care activity system in Tanzania focusing on the tensions around health workers’ working practices due to situational, individual, and organizational factors of work including the interaction between multiple organizational contexts. Within the CHAT perspective, tensions are necessary to understand what motivates particular actions and in understanding the evolution of a system more generally (Kuutti, 1991; Crawford and Hasan, 2006).

For the purpose of the present section, the elements of the health care system in Tanzania as an activity system are identified as follows:

- The health workers (doctors, nurses, and health managers) are the subjects who work together in transforming a shared object to an outcome.
- The primary and shared object of the health care workers is to attend to patients coming to the health facility and the secondary object is the management of the health facility. At the same time, the functioning of the IS is a requirement due to demands from above and the need for information.
- The shared outcomes of these three objects are the provision of health care services and improvement of the health status of the population.
- In order to fulfill the health care organization’s information needs, health workers attempt to control the functioning of an IS with the help of tools (register books, paper forms, pen, calculators, etc.).
- Activities are guided with certain rules and procedures and division of labour. For instance for the IS activities, each level is required to report at the end of each week (for weekly reports), after each 3 months (for quarterly reports), and yearly. Another typical action is expressed at the health facility level where health workers attend patients and collect routine data, which is followed by another important action of preparing reports, which is followed by sending them to the district level.

- Furthermore, there is a community (those who share the common object) consisting of the covered population, patients attending the health facility, doctors, nurses, health managers, and the donor agencies.

**Tensions between various practices and resources**

Health workers at the health facility level are facing tensions between their primary work practices (patient care activities), secondary work practices (management of the health facility), and IS work practices (data collection, report preparation, and reporting). One health worker expressed this in the following way:

There are a lot of registers to fill in and many patients waiting... for example, a child crying, a pregnant mother waiting while tired – this makes the work difficult and complicated.

This tension is partly due to lack of resources and skills for data collection, report preparation, reporting, and storage, which was expressed by the health worker who said,

We had a calculator that we were given at the beginning of MTUHA, which is not working any more. We just use a mobile phone ... We use our money for local transport when taking the reports to the district because if we wait they will say that we are lazy.

The storage of data at the health facility depends on individual health workers’ arrangement: within the same health facility, some keep paper forms and registers on shelves, where it may be eaten by ants, and others keep data in boxes, where rats may eat the papers. Moreover, inappropriate storage and the variation in storage make access to data very difficult. In expressing the lack of proper arrangements for storage and its consequences, the health workers said,

We need somewhere to keep the register books and paper forms for easy access when we need the information... I usually put the OPD register book on this shelf ... but because I am not the only one who uses it ... now I can’t find it ... I have to ask my colleague where it is.

In addition to a lack of material resources, the lack of human resources and skills among health workers also caused tensions between primary, secondary, and IS work processes. For example, in some of the health facilities visited there was only one health worker, so we had to stop the interview so that she could attend the patients to avoid long queues.

In some situations, health workers are careful to follow the work practices that may facilitate other people’s work. When the DMO has to attend ad hoc managerial meetings, s/he requests the DIO for the information to present in the meeting. In this case, the DIO has to do what the boss needs at a particular time while leaving his/her routine activities pending.

When the DMO has to present something in a meeting ...I have to leave whatever I am doing so that I can prepare the required information.
However, in other cases the DMO prepares the required information himself/herself using the district quarterly reports. Most of the district offices are located within the district hospitals. In these situations, the DIO plays more than one role. In expressing his roles one of the DIO said,

I was given the role of the information officer… but when there a lot of patients …I also attend them… because I am trained as a medical doctor.

These ad hoc activities come into conflict with the routine work practices as they are situated in time and contexts of resources, and pose tensions for health care workers in their everyday working practices and roles.

Demands from above: creation of new tools and use of old tools
When it really comes down to the details of responding to their bosses’ demands, the health workers effectively abandon the work processes and fall back on whatever embodied skills are available to them. When MTUHA started, it was declared that all the vertical programmes would be using data collected through MTUHA forms. After some time of operating, different sections and departments such as the MCH department from the MoH started to demand data from the data level that are currently not collected through MTUHA forms. In striving to fulfil the demands from above, health workers have to create new forms for data collection as it was expressed by the district MCH in charge who said:

As the days went on, we are asked for other information that are not in MTUHA forms, which caused us to design our own forms and add more columns in MTUHA registers so that we could get the data the region coordinator is asking for.

This adds more workload to health workers at the facility level who are busy attending patients with poor resources and infrastructure. Some use the old forms, which were being used before MTUHA. For example, in some health facilities, health workers use the old MCH form (named MCH3) for collecting demanded data on the MCH programme. In expressing how this form helps the health facility to collect the extra data required, one health facility worker said,

There was a form before MTUHA called MCH3 which they stopped distributing but found that the data in there are needed. We are asked to report on these data elements so we had to continue using MCH3 in order to be able to report to the district offices.

On the other hand, the DIO expressed this view of the MCH3 form:

Before MTUHA there was a form called MCH3. Health workers at the facility level find it easier to use than the current collection of registers books.

The extra paper forms that the district level has designed for collecting information that is not in MTUHA paper forms has no place in the MTUHA database. In expressing the limitations of the MTUHA software, the DIO said,

In collaboration with the MCH coordinator we have designed paper forms, called ‘mapungufu ya MTUHA’ for collecting additional data on MCH activities that are missing in MTUHA register books used at the health facilities. These additional data have no place in the MTUHA software and we can’t modify the database.

However, health workers at the district level have to use the data collection and processing tools from the MoH regardless of their limitations. This was expressed by the DIO who said:

I have to use the MTUHA software regardless of its limitations because it is the order from the MoH.

There are some reports that are needed by the higher levels or for the district’s activities, for example, a report on the top 10 diseases in the particular district. Currently it is very difficult to prepare such reports mainly due to deficiencies in the reporting. The health facilities only report on diseases yearly, which means in the middle of the year you need go to the individual health facilities to collect data. In addition, there are no tool(s) to help the district health workers in sorting out the top 10 diseases from all the health facilities in a particular district. When describing the process, the DIO said,

We have designed our own form called ‘mkeka’ to be able to find the top 10 diseases.

Each time the health workers at the district have to prepare a top 10 diseases report, they use a very big sheet of paper (joined papers which are pinned together). Due to its size, it resembles a local carpet called ‘mkeka’ (in Kiswahili) used when sitting on the floor. On this sheet of papers, they list all of the health facilities in the district and the reported diseases. Then they count how many times the disease has appeared at each of the health facilities.

There are times when the district health workers have to use the previous year’s diseases reports because of the difficulties in getting the current report.

Sometimes the community leaders call us to go to their community and report the diseases situation in our district but because the data is only being reported at the end of the year… sometimes we repeat the previous year’s report because we don’t have a tool to give us information on quarterly basis.

The difference in relations and their impact on reporting practices
All health facilities (government and private) in Tanzania are required to collect data using MTUHA data collection tools. In practice, health workers in private health facilities collect the data they need for their daily management activities in a separate register book designed by themselves and do not necessarily follow the requirements of MTUHA
since they think data from MTUHA does not help them much as they do not get feedback from higher levels.

If I report to the DMO that my buildings are not well what will they do... they don’t come to repair. So we also have to prepare our own registers for management activities especially on medicines consumption.

On the other hand, private health facilities reported fewer numbers of patients than were actually attended. This is because they pay taxes to the Tanzanian Revenue Authority (TRA) according to the number of patients they are attending. The district health worker expressed this by describing her experience with private health facilities:

One day we were at one of the private health facilities and when we asked the in-charge how many patients he attends he said 3 per day, but while we were there we saw more than 10 patients coming. Then we asked him why have we seen more than 10 patients? He told us that he is reporting less to avoid paying higher taxes to TRA because he is a retired person and the dispensary is his main source of income.

**Situatedness of work practices and organization culture**

The previous section has presented empirical examples on how the contextual influences create tensions at the operational level and how these tensions have prompted the development of new tools. This section uses the presented examples to discuss the situatedness of work practices and organizational culture basing on the following key arguments from CHAT and situated action perspectives. The relation between the organization and the overall object of its activities are mediated by its division of labour and the tools; the relations between individuals and the organization of which they are a part are mediated by rules and procedures (Kuutti, 1991; Engeström, 1999a). In their everyday work practices, actors use common sense procedures to produce, analyse, and make sense of one another’s actions and their situated circumstances (Suchman, 1987; Doerry, 1995). In this discussion, organizational culture is perceived as expressed through the way the organization is structured, how work is done, the aims of the organization, and how management and staff interact within the organization and with those outside.

Moreover, health workers’ work practices are situated within the environment and the organizational culture. From the empirical examples, the local and situated construction of the HIS is achieved by the interplay of the health care worker (at the health facility level, district level, at the regional level, and at the MoH), the tools (register books, paper forms, pen, calculator, etc.), and the infrastructure (the shelves for register books, the folders to keep paper forms, and transport for taking reports to the higher level).

The division of labour, rules, and procedures: tensions in work practices

In providing health care and collecting health care data, several health workers need to engage in the processes and take action within them (Korpela et al., 2004). The empirical examples indicate that work in health care organizations can be described as distributed work among health workers, as well as between health care organizational hierarchies. HIS activities are mainly organized by managers at higher levels for the grassroot levels, for example, the CHMT organizing HIS activities for the health facilities. Distribution of work happens within a specific level, for example, the DMO distributing work between the district health workers. In practice, differently distributed tasks lead to different patterns of work practices, cause tensions for health workers, and limit other activities. In health facilities, for example, health workers have to perform mainly patient care, administrative, and secretarial tasks, which mainly involves paper work. At the district level, the DMO does mainly managerial activities while the DIO is supposed to deal with information issues (collecting reports from the health facilities and preparing the district reports). However, the distribution of work tasks includes problems such as some DMOs delegating emergency report preparation tasks and roles to DIOs, requiring the DIO to adjust his routine work practices. This implies that the DIO assists the DMO in paper work or even attending patients in places where the district offices are located within the district hospital. Consequently, it is often the social connections and practical requirements that lead to a certain division of tasks and roles that might not be seen on any organizational charts or plans (Barley, 1986).

The empirical data indicate that the Tanzanian HIS is still relatively hierarchical with more emphasis on data collection and reporting at the health facility level. According to Markus (1983), organizational tensions and conflicts of authority are well-known problems in hierarchical organizations. The hierarchy can create tensions between DMOs and DIOs, higher levels and grassroots levels because of the politics related to distribution of work, resources, and power. Available resources can be the final creative adaptation to the tensions where individuals use whatever skills and tools they have to fit situational factors. For example, health workers at the grassroots level have designed their own data collection forms to fulfil the higher level’s requirements, which in turn adds more workload, and often have to resort to improvisations, for example, borrowing a calculator from a nearby school teacher.

When considering the contested, temporal, and evolving attributes of organizational culture (Avison and Myers, 1995; Westrup et al., 2002), where there is room for development in the area of how IS affects or mediates organizational culture and vice versa. Equally, exploring organizational culture raises the issue of the environment in which organizations are found. The ethnographic data from this study show that as the days go on, changes in data requirements occur. Consequently, work practices and organizational culture are subject to development and change over a period of time because of the learning going on within the organization. This change is normally incremental and evolutionary and is affected by both external and internal environmental factors. The importance is in understanding these factors and determining how they have had an impact on the development of the present work practices and organizational culture.
When the work practice is disturbed
From the empirical data, we have seen examples on how health workers act upon their immediate surroundings. When the health worker is asked for reports that s/he cannot prepare with MTUHA tools, this is a disturbance (tension). The situation continues to be a tension, especially because similar events are repeated everyday during routine data collection, each quarter during report preparation. The health workers do not stick to the routine MTUHA work practices and, therefore, they handle the tensions by deviating from the standard work practices of the IS. In handling the tensions, health workers change their activities and simultaneously change their skills (Engeström, 1987, 1999a). The health worker focuses on the tensions and begins to search for tools (e.g., the use of mkeka at the district level to prepare the top 10 disease report) to help in achieving the desired outcome. CHAT regards deviations as a normal and valuable part of every work activity, which can be used to refine or evolve the process towards improved efficiencies. In other cases, such as when the MoH or region level asks the district level about a certain report that is not collected using MTUHA tools, the DIO does not conduct their reflective actions of how to report alone. They involve the district supervisors of particular health care programmes and health facility workers, thus expanding the social scope and interactive basis of the actions. This usually results in the development of a new form for collecting and reporting the required information.

In acting upon their contextual influences, health workers at the operational level draw upon interpretive schemes from a number of sources such as medical training, HIS concepts in use, and previous data collection tools that mediate communication and interaction between them and with higher levels. Their response to the requirements from higher levels is strikingly knowledgeable, and motivated by the anticipation of their actions (Bratteteig and Gregory, 1999). Laine (2003: 5) argues that, ‘knowledge and responsibilities are not always visible in the organizational structures but in the more or less hidden social networks’. Moreover, Badker (1991) expresses a sense in which actors are confronted by the separation of their needs (objects) as individuals and the object of the activity in which they take part. The needs of the individual as part of different collective activities might differ and even conflict. For the health worker at the private health facility, there are at least two influential objects of activity: providing health care and doing business, which conflict. The health worker is likely to follow the work practices that facilitate the transformation of the object leading to the achievement of his/her individual needs, for example, the decision to report fewer patients because they want to avoid paying higher taxes to the TRA.

Conclusion
In this article, we have examined the situatedness of work practices and organizational culture. The paper has addressed central themes in IS innovation uptake that are relevant both in low-income and developed countries. The situatedness of work practices and organizational culture is expressed through the tension between the shared objects (primary work practices, secondary work practices, and IS requirements) and the interaction between multiple organizational contexts within and outside the health care organization as an activity system. The identification and understanding of these tensions offers a step forward in current IS research (Cho et al., 2007). It is through understanding systemic tensions that one can best support the continued innovation of the system.

The division of labour, rules, and concrete procedures of the HIS are constructed historically and collectively, in collaboration between health care workers and with their artefacts. The local and situated construction of the HIS also happens collectively. Coordination of activities requires commitment from individual health workers who need to work across and around gaps in existing health care systems. The organizational culture should not be seen as an obstacle to IS innovation uptake, but as an aspect that is intimately linked to what we call the social, political, and economic aspects of people’s lives and their relations with the organizations of which they are part. In addition to Engeström’s approach to activity theory in developmental work research, which binds the individual, collective, and technological aspects of work together, this paper emphasizes the situatedness of work practices, focussing on the influence of the organizational context on actors’ everyday work practices and actions. This emphasis is considered as the main theoretical contribution of the paper.

Notes
1 Mfumo wa Taarifa za Uendeshaji wa Huduma za Afya.
2 Meaning ‘the lacks of MTUHA’.

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Living with Contradictions: Complementing Activity Theory with the Notion of “Installed Base” To Address the Historical Dimension of Transformation

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Abstract

This paper addresses the historical dimension of the relation between information systems (IS) innovation and organizational transformation. We analyse findings from a study of ongoing transformations in the healthcare sector in Zanzibar, Tanzania. The process is described with a particular focus on instances where some contradictions in the old activity system were not resolved but inherited by the new activity system. To address this we complement the activity theory framework with the notion of “installed base” from studies of information infrastructures. This helps to illuminate the theme of unresolved and continuing contradictions, and thus contribute to the concept of historicity in CHAT-informed studies.

**Keywords:** information systems, organizational transformation, cultural historical activity theory, installed base, contradictions, health care, Zanzibar.

1. **Introduction**

Information systems (IS) innovation and organizational transformation is arguably the key challenge facing designers, implementers and users of IS and information technologies (IT) in organization (Sarker & Lee, 1999). Observed challenges include, among other things; uncoordinated communication between the top management and employees about the innovation initiatives at hand and inadequate understanding of the complexities associated with the development and implementation of IT as well as the formal and informal organizational functional areas and procedures.
Furthermore, researchers have challenged approaches to IS innovation and organizational transformation that tended to put emphasis on discrete processes, such as productivity, systems quality, and development costs. These approaches neglect the intentions and actions of key players, the process by which IS tools are adopted and used, and the organizational context within which such events occur (Avgerou & McGrath, 2007). Thus, we need a way of thinking about organizations that retains their complexity yet offers levers and openings for transformation (Baets, 2006).

Activity theory can offer such a way to conceptualise innovation and transformation, and it was the primary theoretical choice for the present study of the Health Information System Programme (HISP)'s activities in Zanzibar. HISP aims at strengthening and improving existing health information systems (HIS) in public health in developing countries. This is done through addressing the problems of multiple data standards and through empowering local users to have greater control of their work processes (Braa, Monteiro, & Sahay, 2004).

Drawing on the notion of the developmental cycle, activity theory was used to capture and analyse the developmental trajectory of the new HIS activity system, as it manifested itself as solutions to internal contradictions in the old activity system as well as in its network relations with other activity systems. However, in this instance some contradictions that emerged during the design of the new activity system were not resolved, but were inherited by the new activity system. To analyse this continuance of unresolved contradictions and thus reveal what historical resources that participants take from one social situation to the next during developmental transformation, we apply the notion of “installed base” from studies of information infrastructures. While both approaches avoid monocausal explanations, they have a different disciplinary and philosophical background and emphasize unique levels of analysis and thus are analytically complementary. This combination of concepts helped us appreciate how past technologies, actions and contexts that were invisible during the planning of the new activity system became increasingly visible only as the new activity system was being embedded in the organizational context.

Analysis of the historical formation of an activity system is essential in understanding its developmental trajectory. It helps to understand the preconditions and precipitating causes of the decisive actions which characterize the formation of the activity system. However, these studies are rare even in studies that employ CHAT (Nardi, 2007). Our study thus also contributes to the relatively scarce literature that addresses the historical dimensions of CHAT-informed research.

The rest of the paper is structured as follows. The next section presents our theoretical framework, focused on the developmental cycle from activity theory and the notion of installed
base from information infrastructure studies. This is followed by a description of the research context and data collection methods. Based on the empirical study of the Health Management Information System (HMIS) design and implementation process in Zanzibar, our analysis and discussion is presented in the subsequent two sections. Finally, in the last section, we conclude the paper by sketching implications for both theory and practice.

2. Theoretical Approaches

2.1. Activity Theory: Developmental Cycles of Transformation

Activity theory or cultural historical activity theory (CHAT) as it is also known, has its origins from the cultural-historical school of psychology in the nineteenth century (Leont'ev, 1978; Vygotsky, 1978). Activity theory is an approach in social sciences that aims at understanding human beings and the social entities they compose in their natural everyday life circumstances through an analysis of the origin, structure and processes of their activities (Kaptelinin & Nardi 2006). Engeström (1987) defined an activity as a system where the main elements are subject, tools and artefacts, object, community, rules, division of labour and outcome. The subjects are participants in the activity who are motivated towards a purpose or attainment of the object. Tools and artefacts are shared cognitive and material resources that the subjects can use to attain the object. The community comprises of individuals or groups who share the same object. Informal or formal rules regulate the subject's participation in the activity. The division of labour refers to both community and vertical division of power and status. The outcome is the results or consequences that the subject finds once the activity is completed.

CHAT and the concept of activity contain many features, like the recognition of actors, mediation, historicity, networking, dynamics and development, to mention a few, which are considered essential in IS research and development (Kuutti, 1991). Consequently, CHAT is adapted in IS research in the sense that both the work practice to be supported and the systems development processes can be conceived as distinct but interrelated activities (Mursu, 2002).

Engeström (2001) described the evolution of CHAT as passing through three generations. The first generation centred on the concept of mediated action: the fact that human's interactions with their environment are not direct ones but are instead mediated through the use of tools and signs. The second generation, differentiated between an individual action and a collective activity. The third generation is concerned with the interactions and overlaps between multiple activity systems. It takes as its unit of analysis the plurality of different activity system that mutually interact; promoting multiple perspectives and voices, dialogues, networks and collaboration between activity systems. These perspectives are presented in a network of minimally two interacting activity systems (Figure 1). In this interaction, the object moves from
an initial state of unreflected, situationally given ‘raw material’ (object 1, e.g. the problem of the patient) to a collectively meaningful object constructed by the activity system (object 2, e.g. an outlook on the patient’s multiple problems), and to a potentially shared or jointly constructed object (object 3, e.g. a collaboratively constructed understanding about the patient’s life situation and care plan).

Furthermore, the interactions and overlaps between activity systems mean that the elements of one activity system are always produced by some other activity system. Likewise, the outcomes of an activity system are usually intended for some other activity system, either as a means, object or subject of the later (Korpela, Mursu, Soriyan & Eerola, 2002). These interactions and overlaps may as well cause contradictions within and between the elements of an activity system as well as between activity systems. These contradictions are historically accumulating structural tensions which emerge in the execution of day-to-day tasks making people to change their activities and simultaneously change themselves. They can be analysed into four levels (Engeström, 1987): primary, secondary, tertiary and quaternary. Primary contradictions refer to inner contradictions within each constituent element of the central activity system. Secondary contradictions appear between the constituent elements of the central activity system. Tertiary contradictions appear between the dominant form of a central activity and an introduced culturally more advanced form of the central activity. Lastly, quaternary contradictions appear between the central activity and its neighbour activities within its network relations.

Thus, activity systems change and develop by resolving their historically evolving contradictions (Engeström, 2000). Accordingly, CHAT acknowledges contradictions as inevitable in the functioning of any activity system and identifies them as useful sources for expansive developmental transformations. Such transformations proceed through stepwise
cycles of expansive learning (Engeström, 1999) or developmental cycles, which we describe in the following paragraphs.

The notion of developmental cycles referred in this paper originates from Engeström’s developmental work research approach to the study and reshaping of work and learning (Engeström, 1991; 2005). This approach expands CHAT by bringing it to the domains of work, technology and organizations. In developmental work research, the activity system of an individual or group is studied and represented in its wider activity context and against the background of the historically evolving contradictions of the activity system. The developmental trajectory of a new activity system is manifested in solutions to the emerging contradictions. Thus, the notion of developmental cycles refers to the processes in which an activity system resolves its pressing internal contradictions by constructing and implementing qualitatively new ways of functioning for itself (Engeström, 1987). It helps to identify different phases in the development of work, technology or organization (Figure 2).

We summarize Engeström’s (1999) descriptions of the ideal actions in a developmental cycle as follows. The first phase is the need state, which involves questioning and criticizing some aspects of the existing practice. The characteristic of this phase is vague discontentment of members of the workplace. The second phase is the analysis. This is a phase when a sharpening contradiction has formed between certain factors of the activity system and therefore the discontentment of the members of the workplace is directed to more clearly defined goals – gaining conceptual mastery of the contradiction. The analysis can be “historical” – seeking to explain the situation by tracing its origination and evolution and or “empirical” – seeking to explain the situation by constructing a picture of its inner systemic relations. The third phase involves modelling in which, on the basis of the analyses, a working hypothesis of the zone of proximal development for the activity system is formulated. Members of a workplace sketch and plan a new solution to present contradictions. This involves actions such as developing new strategic instruments and forms of collaboration and division of labour. The fourth phase involves testing the model through applying it in everyday work. The aim of this phase is to grasp the partial solution’s dynamics, potential and limitations. The fifth phase is the implementation of the model through practical applications and conceptual extensions. Finally, the sixth phase is the consolidation and assessment of a new line of activity. This phase means transition to a state where new practices are followed systematically and the outcome of a developed model becomes a new form of practice.
The six actions are described by Engeström as phases of an outwardly expanding spiral, but multiple kinds of actions may take place at any time. The details and implementation are constructed and learned as the work community works its way through the developmental cycle. In this process the IS development becomes a part of the transformation of the whole activity to solve its contradictions.

Extant researchers using CHAT perspectives have analysed the expansive cycle of work activity systems as well as networks of activity systems in multi-organizational fields. For example, Foot (2001) used the expansive cycle to analyze the historical development of the network for an Ethnological Monitoring and Early Warning activity system; relations within the network, the evolution of the network’s complex object, and the network’s development of its tools. Spasser (2002) used the expansive cycle to describe how attempts to resolve internal contradictions among the participants in a digital library project entailed its expansive development and reconceptualization. In his intervention research on modelling school library programmes and practices, Meyers (2007) used the expansive cycle to identify contradictions and tensions aiming to design and implement new practices to improve student learning through the library school. It can be said that the focus in these studies have been on identifying contradictions and attempt to resolve these contradictions, which led to expansive developments of respective activity systems. In this regard, they reveal the historical developments within the respective activity systems. This is inline with Foot (2001, p. 58)'s argument that, "historical perspective is essential to the analysis of an activity system's expansive cycle.” However, as it is with other sociocultural approaches (Callanan, 2006), the historical dimension within the CHAT
perspective is not explicit about what historically formed contradictions are carried from one
form (old) of the activity system to the next (new).

2.2. **Infrastructural Aspects of Information Systems: The Notion of an Installed Base**

In order to complement our analysis using CHAT conceptualization, we now turn to the notion
of “installed base”. This comes from studies using the information infrastructure metaphor,
which draws on the traditional concept of infrastructure (David & Bunn, 1988; Hughes, 1987),
denoting the basic installations and facilities on which the continuance and growth of a society
depends. The notion thus emphasises that which underlies our society, the subsumed and
hidden elements (Star, 2002), that which supports our activities in different ways (Star &
Ruhleder, 1996). Moreover, the notion of information infrastructure contrasts with the notion
of information system in terms of its size and complexity. In contrast to the relatively delineated,
predictable and closed systems, an information infrastructure is open and evolving in the sense
that more components can be added and more users can become enrolled. An information
infrastructure is a shared resource for the community, serving multiple users and use areas, not
only a few, predefined ones (Hanseth & Lyytinen, 2004).

Information infrastructures are complex heterogeneous socio-technical networks in which the
historical and pre-existing, the ‘installed base,’ plays a crucial role (Monteiro & Hanseth, 1995).
The installed base is understood not just as installed technical systems, but as the inter‐
connected practices and technologies that are institutionalized in the organization. Thus, work
routines, organizational structures and social institutions are very significant elements of the
installed base.

The notion of installed base carries an important corollary; namely that an information
infrastructure is never developed from scratch. It is built upon something already existing in the
form of social practices, artefacts, rules, division of labour and heterogeneous actor-networks of
humans and technologies (Hanseth & Monteiro, 1997). When designing a new information
infrastructure it will always be interconnected with the old one in some way or another. Even
when the aim is to replace the old information infrastructure, the new need to start from and
relate to the old one during the transition process. Consequently, information infrastructures
are not *constructed*, they *evolve* through extending and improving the installed base. Thus, the
installed base affects the new solution, and future changes may be facilitated or hindered
because of this.

The role of the installed base in shaping the future is clearly illustrated in a study of the debates
around the so-called “next generation Internet”. Monteiro (1998) describes the process from the
late 1980’s until 1994, when IP version 6 was finally selected to replace IP version 4. There
were many other candidate protocols, but IPv6 could offer a realistic transition strategy from an internet based on IPv4. This became a significant reason for the choice, and it shows how the need to link with the installed base took on a decisive role.

There are different mechanisms through which the installed base impact future development. All organizations have a need for maintaining stability in the installed base in spite of continuous change and evolution, and the installed base can be practically difficult to replace due to its size and complexity (Rönnbäck, Holmström, Hanseth, Borg, Frykman & Thomsson, 2006). This is for instance reflected in the information systems field’s emphasis on legacy systems problems. The same inertia issues can be seen with respect to information infrastructures, since as an information infrastructure grows, the installed base may become increasingly hard to change. For instance a standard (for a product or a solution) may gather momentum and size through self-reinforcing mechanisms, resulting in a lock-in situation where the switching costs and sunk investments make change unlikely, although not in principle impossible (Hanseth & Lyytinen, 2004).

The inertia of the installed base does not imply that information infrastructures are impossible to innovate. Systems do change, but not always according to the initial plans and designers’ control. For instance, Ciborra (1997) and Ciborra & Associates (2000) used the notion of ‘drift’ to describe the emergent improvisations happening when a technology is put into real use situation, as opposed to what was planned before implementation. In this regard, the alignment between technology and organization is a process of conflict and negations between different actors including the technology itself.

These mechanisms are not solely related to installed technical systems. As Braa & Hedberg (2000) argues from studies of health information systems (HIS); these systems are embedded in social work practices and are barely separable from the social context of which they are part. The installed base then includes existing knowledge and experiences, tools, routines etc. In this regard, all aspects of modifying, integrating, and replacing existing information systems and technologies have a direct impact on the existing health care organization’s activity system, the installed base, as a whole. Therefore, the question is not only whether the different social groups, practices, paper-based documents, databases etc. are aligned with each other for the new solution to work, but also whether the new (proposed) activity system can be reached from the old system through a realistic transition strategy.
3. **Context and Methods**

This paper reports on the initiatives taken by the HISP project in improving and modifying the HMIS in Zanzibar. With its origin in South Africa, HISP is currently working to strengthen and improve existing HIS in a network of developing countries including Tanzania (both Mainland and Zanzibar). HISP has developed a District Health Information Software (DHIS) used for data management. DHIS is freely available and open source software (however, the actual version used in Zanzibar is based on MS Access) and it can be customized according to a specific setting's requirements. Thus, HISP introduces computers and software and train health workers in data handling processes and use of information. However, bringing about this change in practice is a complex and long-term process. One of the reasons for this is the nature of the existing systems and structures in particular health care organizations, which we argue need to be taken into consideration.

Given our focus on the relation between information systems (IS) innovation and organizational transformation, the methodological directive was to study HISP’s activities within the context of the health care organization involved. The research approach was inspired by ethnographic research methods, since ethnographic research is well suited to provide IS researchers with rich insights into the human, social, and organizational aspects of IS (Myers, 1999). With ethnographic methods the researcher combines watching, participating, asking and listening to a certain group of people. The empirical findings presented in this paper were collected by the first author who is a member of the HISP team in Zanzibar. She played the role of an action researcher and a participant observer in the design and implementation of the HMIS for Zanzibar for an extended period of time. The data collection took place through distinct but overlapping fieldwork phases. Data collection was done during the period of from December 2005 to May 2006 and then from October 2006 to December 2006. It integrated narrative analysis of participants’ accounts of past innovation efforts with analysis of documents and material traces of innovation within the HMIS activity system.

Thus, in addition to the day-to-day involvement in the work, semi-structured interviews were conducted with 30 health workers from various levels of the health care sector in Zanzibar. Detailed notes were taken during the interviews and observations that were then transcribed on the same day (at the end of each day). Furthermore, documents analysis, informal talks and discussions played a major role during data collection. Documents that were analysed include the HMIS implementation plan and progress reports, user guidelines and data collection and reporting forms. The interviews and the documents analysed provided empirical data on the HMIS design and implementation period (in 2005) before the commencing of the fieldwork.
Understandings from these various sources of research data were developed following the principle of triangulation (see Patton, 2002). In this process we considered and analyzed what we learned from different sources of data and diverse perspectives generated from the interviews, participant observation and analysed documentary sources. The analysis of the empirical material was informed by the selected theoretical framework whereby the concept of the developmental cycle has been used to describe and analyze the studied transformation process. Following that, the concept of installed base has been used to identify re-occurring contradictions that emerged from characteristics of the previous activity systems. First, however, a general description of the case setting is offered.

3.1. Health Care Sector and HMIS: An Overview on the Historical Developments

After the revolution in 1964, Zanzibar established a post-revolution health policy, in which the government declared free access to all the citizens with an emphasis on disadvantaged groups in the rural areas, particularly women and children. Through implementing this policy the health service infrastructure was improved to a situation where the majority of the population live within 10 kilometres of health care facilities (MoH, 2002). However, the country continues to face high burdens of diseases such as malaria and communicable diseases like TB and HIV/AIDS. In addressing the burden of diseases, several disease-specific programmes, mainly supported by donor agencies were initiated. An unfortunate, but well known result of so-called vertical health programmes is the creation of multiple separate and parallel systems of data collection, compilation and reporting (Chilundo & Aanestad, 2004).

Administratively, the health care sector in Zanzibar consists of four levels: the health facility level where primary health care units (PHCUs) and primary health care centres (PHCCs) provide basic curative and preventive (mother and child programmes) health care, the secondary level where there are hospitals serving as referral points for the primary level health care facilities, the tertiary level where there is a specialized and teaching hospital; the district level; the zone level; and the national level – the Ministry of Health (MoH). Health care data collection was done at the health facility level (PHCUs, PHCCs, and Hospitals) and sent to each specific vertical programme as well as to the MoH through the district level. This situation is described in Figure 3.
As part of the health sector reform in 2000 the Ministry of Health (MoH) in Zanzibar established a unit for information management known as the Zanzibar Health Management Information System (HMIS) unit. The HMIS unit was a result of uniting the three sections within the MoH: the Epidemiology, Research and Statistics sections (see Figure 3). The HMIS was declared an important tool to facilitate monitoring and evaluation of health care services delivery throughout the country (MoH, 2002). While there existed both governmental and non-governmental health facilities, the HMIS covered governmental health facilities only. The HMIS was paper based with no comprehensive national data standards. For instance, there were no “essential data sets” defined at various levels, nor were there data dictionaries for data elements and indicators, or standards for collecting, analyzing, and reporting health data. In addition, despite its establishment, vertical health programmes continued to use their individual and separate information systems.

In November 2004, the MoH and its stakeholders conducted a HMIS review which revealed the fragmentation and the lack of health care data to support decision making. Specifically there were excessive amounts of data being collected, and there were overlaps and inconsistencies in the data reporting between the established HMIS and the information systems within the vertical programmes. As a result of these findings the MoH and other stakeholders decided to undertake a project to improve the HMIS in Zanzibar. The HISP project was contracted to design and implement the revised HMIS for Zanzibar in collaboration with the MoH.

In summary, the establishment of the HMIS in Zanzibar was primarily driven by two main objects of activity that emerged within the health care sector: socio-political concerns about people (the population) and their illnesses, and the health sector reforms as stated in the Alma-
Ata declaration (1978). In this regard, increased coverage of the health care infrastructure and the HMIS, among other things were seen as tools and artefacts for transforming the stated objects into a joint outcome: improved health care services for the population. After its establishment in 2000, the HMIS became an activity system in itself, consisting of the object of activity, subject, division of labour, rules and procedures, community, and tools and artefacts (Figure 4). During its operation contradictions emerged within and between its elements as well as in its network relations with other activity systems, which paved ways for later innovations and thus its developmental cycle.

Given the historical context, in the next two sections we present, analyse and discuss HISP’s initiatives towards the development and implementation of a national HMIS for Zanzibar. We first apply the notion of developmental cycle from CHAT to illuminate the HMIS innovation and health care organization transformation trajectory. The focus is on describing how attempts to resolve contradictions within and between the elements of the old HMIS activity system as well as within its network relations with other activity systems (Figure 4) have collectively led to its expansive development. Then we zoom in on the recurring and unresolved contradictions using the concept of installed base from information infrastructure.

4. Activity Theoretical Analysis

4.1. The Network of Activity Systems

The unit of analysis is what we call the HMIS activity system seen in its network relations with other activity systems. There are several activity systems within and outside the health care sector that interacts and overlaps with the HMIS activity system (such as the health care education activity system, the medical professionals’ employment activity system, health care provision activity system, etc.). However, we have chosen to focus our analysis on its interactions and overlap with three activity systems, most notably the health care provision activity system in Zanzibar as a whole, the health management activity system, as well as multiple activity systems of the different vertical programmes (Figure 4). This is partly due to the research focus, which based within the health care organization and partly due to the immediate impact of the chosen activity systems to the development of the HMIS activity system. Furthermore, our analysis is limited to the time period between 2001 and 2006.
When viewed within a network (Figure 4) the four activity systems share some of the subject, part of the community, part of the rules, as well as the outcome of the activity (i.e. improved health of the population). In their interactions, the HMIS activity system is a tool producing activity; it is supposed to produce information for decision making (i.e. for the health management activity system as well as for the vertical programmes activity system). Likewise, the health management activity system and the vertical programmes activity system are tool
producing activities for the HMIS activity system (providing data collection, analysis and reporting tools). While the health care provision activity system is the object (health care data) producing activity for the HMIS activity system, it can as well be seen as a tool (health care data) producing activity for the vertical programmes activity system. This is based on the fact that vertical programmes could obtain health care data directly from the health care provision activity system without passing though the HMIS activity system.

The health management activity system is a rule and division of labour producing activity for the health care provision activity system, the HMIS activity systems, as well as some rules for the vertical programmes activity system. The vertical programmes activity system is a tool and rules producing activity system for the health care provision activity system. However, this network was deeply fragmented because of differing objects between the health management activity system and the vertical programmes activity system, which resulted into different and separate tools for the HMIS activity system. This description is not exhaustive but rather provides examples of network relations that form the basis for the analysis of contradictions underlying the developmental trajectory of the HMIS activity system, which we describe in the next subsection.

4.2. Developmental Cycle of the HMIS Activity System

After the establishment of the HMIS in 2000 several separate and parallel systems for data collection, compilation and reporting continued to operate within the health care sector in Zanzibar. The existence of these systems was perceived as problematic by health workers at health facility and district levels. Moreover, despite the existence of several systems, the MoH and its stakeholders experienced a lack of information for decision–making. This situation led to questions and critique of the existing HMIS practices. For the health workers, the questioning took place in the daily engagement in the collection and reporting of health care data, and in particular when experiencing the increasing demands for data from various stakeholders within the health care sector. For the health care managers at the MoH and its stakeholders the questioning of the HMIS activity system took place in relation to a process of continuous health sector reforms. This questioning characterises the need state phase in the developmental cycle of the HMIS activity system.

In 2004, through regular meetings, health workers and health care managers began sharing some of their questions about existing practices within the HMIS activity system. As a result, in November 2004, a joint HMIS review between the MoH and its stakeholders documented the problems with the HMIS: the fragmentation and the lack of health care data to support decision making. The following excerpts from health workers illuminate how they experienced the contradictions:
As a result of the questioning in the need state phase, both historical and empirical analyses of relevant issues were conducted by the MoH and its stakeholders during the analysis phase in December 2004. During this phase other actors became involved in the analyses: a masters student from Zanzibar studying at the University of Oslo and other members of the HISP network. The historical analysis involved issues like identifying the origin of problems within the HMIS. These were found to be scarcity of resources - both material and human, gaps in data collection, inappropriate analysis and reporting tools, fragmentation of IS and poor feedback mechanisms. The empirical analysis involved issues such as health care information requirements for local managerial decision making as well as for meeting the millennium development goals (MDGs). These analyses revealed additional contradictions to those identified during the need state phase, which are illustrated by the following excerpts from the interviews with actors involved in the analysis phase:

*We had a lot of forms to fill in data at the same time a lot of patients to attend. Some of these data were related but collected in different forms. For example, Safe Motherhood and Nutrition are separate programmes with separate data collection tools but some data are similar* (Health worker, at the health facility level).

*We needed software to help us in data analysis. For example, preparing a top ten diseases report...it was very difficult to prepare - we had to go back to the health facilities looking at their daily collected data ...if at the district we needed to know the top ten diseases in our district* (Information manager, at the district level).

*It was difficult for us to collect data from all the districts at the end of each month. As a result, the overall health care data for Zanzibar at the end of each year were incomplete* (Health worker at the MoH).

Based on Engeström (1987)'s categorization, the above empirical findings from the period we analyse as the need state phase illuminate three levels of contradictions: primary, secondary and quaternary. Primary contradictions are contradictions within the tools (different tools which sometimes collect similar data and lack of tools for data analysis); within the subject (high workloads); and within the community (lack of consensus among the different health care stakeholders with regard to the system for data collection). Secondary contradictions are contradictions between the object and tools (tools not able to fulfil the needs for data); between the subject and tools (health workers having to fill in so many forms); between the subject and the object of activity (few health workers who have to attend patients, collect data and prepare reports). Quaternary contradictions are contradictions between the HMIS activity system and the health management activity system (the collected data not facilitating decision making); and between the HMIS activity system and the health care provision activity system as well as the vertical programme activity system (the same health workers have to participate in both activity systems).

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We need harmonization between the Ministry and other donor funded health care programmes such as EPI, Safe Motherhood, HIV and AIDS so that we can collect data with one system. Many separate systems give burden to health workers – mainly data collectors – who are few and when looking at their skills, they can’t analyze the data (HMIS manager at the MoH).

The HMIS could not provide us with the data we needed at specific time intervals. Therefore, we had to design our own tools for data collection and reporting (Vertical programme manager).

The findings indicate that the additional contradictions that were revealed during the analysis phase were mainly secondary and quaternary level contradictions. Secondary level contradictions includes contradictions between the object and rules and procedures (lack of standardized reporting routines); between the subject and the tools (lack of skills in using the tools); and between the subject and the community (doctors and nurses at the health facility level required to collect similar data to report to multiple health care stakeholders). Quaternary contradictions include contradictions between HMIS activity system and the vertical programmes activity system (the HMIS not able to fulfil the vertical programmes’ need for data); and between the HMIS activity system, the health management activity system and the vertical programmes activity system (similar and parallel data requirements from both donors supported vertical programmes and the MoH).

The need state and analysis phases of the developmental cycle of the HMIS activity system involved the use of regular meetings, interviews, observations and discussion groups as methods of identifying the existing contradictions. In his study on using CHAT to model school library programmes and practices, Meyers termed these stages of the process as the ‘ethnography of trouble’ (Meyers, 2007).

In January 2005, a workshop involving health care stakeholders, the MoH and HISP members was conducted. This workshop produced a decisive action plan of HMIS innovation which moved the developmental cycle into the modelling phase. This resulted in an innovation model, which represented the zone of proximal development for the HMIS in Zanzibar. The action plan describing the HMIS innovation model involved: the development of essential datasets and indicators, the development of data collection and reporting paper forms; customising the DHIS to meet the information requirements; and training health workers in data collection, DHIS and HMIS in general (see Figure 5). The development of this model was an attempt to resolve both the primary, secondary and quaternary contradictions that were illuminated during the need state and analysis phases. In the interview with the health manager at the MoH, he explained the establishment of the model as follows:

A strong commitment to develop an effective and integrated HMIS came out of the workshop, and a plan of action- referred to as the HMIS “roadmap” was agreed upon (Health manager at the MoH).
The model played a dual role: it precipitated a new mode of a joint activity between health care stakeholders, and it indicated a way to the resolution of some of the identified contradictions. However, it also created other contradictions during its testing period, and thus more innovation. These will be further described below, let us however first note that Meyers (2007) describes such contradictions as those that arise when new ways of thinking or doing come in conflict with traditional or existing ways of thinking and doing. In Engeström (1987)’s categorization, such contradictions are referred to as tertiary level contradictions. In this case the model should not be considered as naïve and unscientific, but as an intervention based in a careful analysis of practical activity, with an historical analysis illuminating the origins of these conditioned practices (Engeström, 2005). In this regard, the establishment of the HMIS innovation model is the focal point for understanding how expansive development take place (Engeström, 1999) – through the construction and resolution of successively evolving contradictions in a complex health care system.

In February 2005, both the HISP members, health workers and health care stakeholders engaged in designing and testing the model. This is what we term the testing phase in the developmental cycle. The design and testing process started with the development of essential datasets which went in parallel with the design of data collection forms. Essential data sets were derived from the existing data collection forms from various health care programmes. However, the layout of most of the old forms was changed into what was considered as a simplified and standardized layout. For example, whereas in the so-called “stroke form” (the previous form in the OPD – out-patient department, see Appendix A) health workers used tallies to record the patients, in the new OPD form the design was changed to 00s (see Appendix B). In this case, health workers were required to tick a 0 for each patient attended. The use of 00s design in the new form was based on the idea that there should be a standardized layout of the data collection forms. Since other forms such as the Expanded Programme on Immunization (EPI) form used the 00s design, it was feasible that the new OPD should also use the same design. Moreover, whereas in the old data collection tools the language used was a mix of English and Kiswahili, most of the data elements in the new data collection tools were in English only. This was also based on the argument for standardizing the language used in the data collection tools, taking into consideration the fact that there didn’t exist Kiswahili names for many of the data elements and diseases.

The new designed forms were then tested in the three pilot districts and then revised as per users’ feedback. The DHIS (software system) was then customized and tested in the three pilot districts from July 2005. As stated earlier, during the testing phase new contradictions between the old HMIS practices and the new ones emerged. The following excerpts from the HISP
members, health workers and health care stakeholders illustrate the illuminated contradictions that emerged during the testing phase.

I do not understand definitions and procedures in collecting the required information, mainly on the newly introduced data elements such as fully immunised under one year [EPI report], children born protected [EPI report], maternal/child deaths [RCH report] (Health worker at the health facility level).

We are not yet sure if the MoH can provide us with all the data we need. Therefore we will keep using our old forms parallel to the new forms until we are sure that the new HMIS forms can provide us with all the data we need. (Vertical programme manager)

Currently, there is no specific person who is responsible for the storage of forms and keying the data into the computer system [DHIS]. It is more of an individual initiative (Health worker at the district level).

Likewise, to some health workers with difficulties in understanding English the use of only English language in the new designed data collection forms posed a problem. They could not understand what to fill in for a particular data element and in some cases filled in wrong values. This was evident from the following excerpts from health workers.

The new forms seem to be simple to fill in because they have a reduced number of data elements... but I do not understand some of the data elements since they are in English only. I was used to the ones which had their Kiswahili translation in the previous forms. Therefore, I am filling them based on my own understanding which could be wrong (Health worker at the health facility level).

What is the difference between’ total head count’ and ‘diagnoses’ when I am filling in this form? The previous form had total head count written in Kiswahili too ... so it was easy for me to understand what to fill in (Health worker at the health facility level).

After six months of testing the new data collection forms and the software system the model was reviewed according to the health workers recommendations. The review covered both data collection and reporting tools (paper forms and the software system), as well as the routines, and it was done through a workshop which was conducted at the national (MoH) level. The workshop involved two to three representatives from each health care levels, vertical programmes and health care stakeholders. The first author of this paper participated in the workshop as a member of the HISP team. During the workshop the participants shared their concern about the model focusing on the use of the paper forms and the DHIS. As a result, more contradictions were revealed as the following excerpts from health workers point out.

The training we had was done in one day. During this time we had to learn all the details in sixteen different forms. As a result the time was very short to get acquitted with all the forms, therefore we need more training (Health worker at the health facility level).

We can use the DHIS to enter data and send to the MoH but with our limited knowledge in computers we can not do the analysis because we are still not familiar with the available analysis functionalities within the DHIS (Health worker at the district level).
In some cases the changed layout of the forms was confusing. For example with the OPD forms, several problems were evident. Some health workers did not know what to do with the 00s and in other cases the ticked 00s were not representing the reality. This was expressed by the health workers, who said,

_We were used to the stroke form where we tallied according to the patients we are attending. With the new OPD form it is confusing_ (Health worker at the health facility level).

_The 00s are equal for all the diseases while in reality some diseases have more patients than others, therefore when I tick all the 00s available on a particular disease and when I continue attending more patients with the same disease I do not record anywhere_ (Health worker at the health facility level).

Furthermore, despite the agreement on data elements and the use of HMIS forms for data collection and reporting, some vertical programmes continued to use their old forms as a way of collecting the extra data elements that were reduced. This was observed by the researcher during a visit to the health facilities as well as by the health worker who said:

_We have other forms which we got from Mr. [...] from the vertical programme. They are three forms in bunches specifically for that programme for the whole year. This is strange because we were together in the designing and training of the new HMIS forms_ (Health worker at the health facility level).

As the above findings indicate, the tertiary contradictions that emerged during the testing phase included the following: health workers were not able to use all DHIS’ functionalities due to the fact that the previous HMIS practices were mainly paper based and also they did not have skills in using computers; health workers did not understanding the new data elements; the absence of a specific health worker responsible for data collection and storage; new reporting routines and procedures which health workers were not use to; vertical programmes requiring immediate results from the MoH - since they had to receive data from the new HMIS, which was contrary to their previous ways of data collection where they had their individual data collection and reporting systems; and old tools running in parallel with new tools.

At the same time the workshop was a means of solving some of the contradictions through a thoroughly debate and discussion between the HISP members, health workers and health care stakeholders. The debate at the workshop went back and forth focusing on the need for more elements (from the vertical programmes’ point of view) versus the need for simplified and indicator based data elements (from the HISP and MoH point of view). In this situation, actors needed to develop an agreeable solution to the contradictions and recognize the systemic and collective nature of their problems instead of managing the contradictions with individual solutions (Engeström, 1991). However, in our case some of the contradictions were not solved and instead the old ways of working were re-adopted. For instance, after the review, the layout of the new OPD form was re-designed providing the possibility for health workers to tally as
they were used to with the stoke form (see Appendix C). Likewise, it was agreed to continue using both English and Kiswahili in naming some of the data elements in the new forms. We will return to the analysis of old ways of working that were inherited in the new HMIS activity system using the notion of installed base.

In addition to finding solutions to the emerged tertiary contradictions, during the workshop health workers pointed out to the potentials of the new system based on how it simplifies their work and facilitate the report preparation and feedback mechanisms.

*The new forms are more user friendly than the old. The forms are simpler, with fewer elements to fill in* (Health worker at the health facility level).

*With the DHIS' analysis tool we can easily make a report on the top ten diseases for the population basing on specific age groups, something which we had difficult in preparing before. As district managers we can prepare an overall report for all the health facilities in the district and use it for providing feedback to the health facilities* (Information manager at the district level).

January 2006 marked the initiation of the **implementation phase** whereby the model was implemented throughout the whole of Zanzibar. The newly designed data collection forms were distributed to all health facilities. Similarly, the DHIS software was installed in all health care districts, zones, the MoH and in the vertical programmes’ offices. During the implementation phase, tertiary and quaternary contradictions continued to emerge. These contradictions centred on historically developed inner contradictions within the old HMIS activity system and its network relations with the vertical programmes activity system. Such historically developed contradictions include non-institutionalised procedures for collecting some of the data, unclear roles and responsibilities with regard to health care data management and strong institutionalized practices from vertical programmes. For example, in the monthly disease surveillance report, the number of deaths and infant and maternal deaths were always zero (0) because there is no specific system for collecting these data in the health facilities – they are supposed to be collected and reported from the villages (known as Shehias), something which did not happen even before the development of the new HMIS. Health workers at the health facility level had such strong trust in the organization and management of the vertical programmes to an extent that they continued to use the old data collection forms in parallel with the new data collection forms. The main argument from the health workers was that,

*No one from the EPI programme managers has told us to stop using the old form* (Health worker at the health facility level).

Moreover, during the formation of the HMIS unit in 2000, the definition of roles and responsibilities for health care staff with regard to HMIS had not been adequately undertaken and communicated to the lower levels. As a result, most district and health units’ staffs were not
aware of their specific responsibilities and from whom to seek help with HMIS related issues. This was evident from the following excerpts from health workers.

*When I have problems on something with the HMIS, I do not know who in particular to consult – either at the zone or ministry* (Health worker at the district level).

*Most health workers do not know who to consult with regard to HMIS issues because the communication and coordination between the higher levels and lower levels did not exist and it needs to be established* (Health worker at the district level).

The consequences of unclear roles and responsibilities with regard to health care data management was evident partly at the district where we observed unorganized collection and storage of reports from the health facilities and partly in a review meeting which was conducted in June 2006 after six months of countrywide use of the new HMIS.

Since countrywide implementations of the new HMIS in January 2006, the HISP team in collaboration with the MoH and its stakeholders have been engaged in what Meyers (2007) termed as the ‘ethnography of transformation’- *consolidating and assessing* the outcomes of the new HMIS. During this phase, health workers at various levels of the health care system have been trained and given on-site support on how to use the paper forms and the software system. Furthermore, following one year of using the new HMIS, a guideline document that specifies the full authority, directives, roles and responsibilities of various HMIS stakeholders was developed in December 2006. Based on the financial capacity and their strong institutionalized practices, the vertical programmes were given the responsibility of producing and distributing the new data collection forms for their respective programmes. Although parts of the old HMIS practices continued after the change, there were also signs that health workers and health care stakeholders saw their practices in a broader context and as an opportunity to achieve the object of the HMIS activity system, which was reconceptualized to include minimum but essential datasets to cater the needs of different health care stakeholders. This was illustrated by the health workers during the interviews who said:

*When the deadline for receiving reports from the health facilities pass I make follow-up to find out what is the reason for the delay...and solve the problem which caused the delay* (Information manager at the district level).

*Before we used to make the budget based on estimates mainly because we could not get all the data from all the health facilities, but this time the budget which was done in July 2006 based on the data we collected through the new HMIS* (Health worker at the MoH).

The developmental cycle within the HMIS activity system in Zanzibar for the period of 2001 - 2006 is summarized in Figure 5.
Figure 5: The HMIS developmental cycle, 2001-2006
5. **The Inertia of the Installed Base**

In this section, we draw upon the notion of installed base from the information infrastructure literature to explore and analyze how past technologies, actions, and contexts impacted the process. Despite the careful historical analysis during the analysis phase of the HMIS developmental cycle, many of these issues were more or less invisible during the modeling of the new activity system and only became increasingly visible as the new activity system was embedded in the organizational context, during the testing and the implementation phases.

In the context of the HMIS in Zanzibar, the installed base consisted of the historically existing fragmented technologies for data collection and reporting: both paper-based and computer systems, datasets, and institutionalized work practices. Since the HMIS installed base was entrenched in a complex interconnected social-technical, political, and cultural context, the design and implementation of the new HMIS process was subject to these contextual influences (Monteiro & Hanseth 1995). The zone of proximal development for the HMIS in Zanzibar indicated that the overall health service could be improved through integrating existing related fragmented datasets and technologies to produce standardized, comprehensive, minimum but essential datasets and tools that could be used and shared amongst all the relevant stakeholders. During the testing and implementation phases of the HMIS developmental cycle, the installed base characteristics became evident and they influenced the ongoing design and interaction between the health workers, with the new datasets and data collection tools.

For example, the emergent characteristics from the installed base were evident in the case of the new OPD form which was derived from the existed 'stroke form'. Before the testing phase, the use of tallies in the stroke form was not recognized as an important characteristic of the installed base. Only after this aspect had been changed and resulted in reported difficulties of using the new OPD forms by the health workers, was the role of this aspect recognized. Likewise, the language artefact is an example of the installed base which was not recognized to be important during the modelling phase of the new HMIS. This became illuminated only during the testing phase.

These characteristics emerged as tertiary contradictions in CHAT’s sense: between the old ways of working, which did not have standardized data collection tools in terms of layout and language in this case, and the new ways of working, which considered a standardized layout of forms and language used as important aspects. From a CHAT perspective, a solution for these contradictions had to be found for expansive development to take place (Engeström, 2000). However, CHAT does not put explicitly whether adopting some of the old ways of working (using tallies in the new OPD forms in this case), which contradicts with the new ways of working (forms with similar functionalities should use 00s) is part of the solution. Taking the
concept of installed base into account, our study indicates that old practices, which emerges as contradictions during the design of the new activity system can as well be part of the solution and thus facilitate the functioning of the new activity system. Likewise, Hanseth & Monteiro (1997) argue that the installed base impact new IS solutions and future changes may be facilitated or hindered because of this.

In this regard, the stroke form layout and the language artefact represented strongly institutionalized aspects of the installed base which had to be inherited by the new system. In other words, tallies and a mix of English and Kiswahili languages represent an installed base, which to some extent lead to a tool- and artefact-based lock-in that made it difficult to change.

Moreover, as our study shows, the health workers at the health facility level continued to use the old forms in parallel with the new forms because they had not received instructions from the vertical programme managers on stopping using the old forms. The continuation use of old and new forms also point to another significant aspect of the H MIS installed base in Zanzibar: a high level of centralization, where resources and information requirements, among other things, originate from the national level and are directed down through the administrative hierarchy. As a result health workers’ work practices with regard to the H MIS at the lower levels depended mostly on directives from the higher levels – mainly the MoH and vertical programmes coordinators. In this case, health workers attribute institutional trust to the existing routine systems and see them as means to confirm social contracts (Braa & Hedberg, 2002). This situation can be described as the inertia of the installed base resulting from strong institutionalized practices within the vertical programmes. In addition, this inertia was partly attributed by the vertical programmes’ lack of trust with regard to the capacity of the MoH to ensure sustainability of the integrated H MIS. This was in turn due to historical poor financial capacity of the MoH.

In CHAT’s sense, the above illuminated inertia of the installed base emerged as tertiary contradictions between the old ways of working, in which the vertical programmes had control and authority over the collection and reporting of their individual disease specific programmes and the new ways of working in which the data collection and reporting is integrated and shared among all health care stakeholders. Taking the limited financial capacity on the part of the MoH and strong institutionalized practices on the part of the vertical programmes into account, it seemed sensible to give authority and responsibility to the vertical programme managers to maintain the production and distribution of the new integrated data collection tools which deal with their specific programmes.
6. Conclusion and Implications

Through our empirical study within the health care organization in Zanzibar, we have analyzed the process of IS design and implementation and the organizational transformation resulting from this process. This we have done drawing on the notions of the developmental cycle from CHAT and installed base from information infrastructure.

Our analysis shows that organisational transformation around IS innovation are not clearly identifiable as problem-solving process, but the design and implementation activities are embedded in complex work practices. In this process the installed base that initially was invisible (during the modelling state in the developmental cycle), became increasingly visible as the system was embedded in the organizational context. The visibility of the installed base indicates to what extent IS innovation and organizational transformation is an ongoing process of negotiations involving both plans and creating a self-reinforcing process where an infrastructure of installed base provides useful resources and services for users. Furthermore, the mechanisms at work at the operational level are only partly controllable by management techniques, and often so interwoven with local culture and routines that in practice it is impossible to predict the outcome.

The result observed in our case yielded somewhat to the inertia of the installed base, and we argue that this may be regarded as a sensible compromise between the installed base and the new HMIS activity system. Consequently, IS innovation and organizational transformation does not solely imply solving the arising contradictions, but also making sense and reusing some of the different aspects of the installed base. For the IS to function and a common object to take hold in practice, system designers and implementers will need to view some of the aspects of the inertia of the installed base as complementary to the new ways of working, rather than contradictory. This implies that decisions on how to continue to live with some of the contradictions also need to be done.

While our analysis has been developed based on the empirical study within the health information systems and health care organization in Zanzibar, we believe that the study has broader implications for other countries dealing with IS innovation and organizational transformation processes. Future IS designers and implementers can benefit if they approach IS innovation and organizational transformation as an ongoing temporal process of interpretation involving participant’s current object or intention, as well as past social interactions, use of tools and artefacts. Theoretically, this study can contribute with an example of the role of the historically existing characteristics of the activity system, or the installed base. The case study illustrates how the installed base may oppose change, and how change may not always be progressive and complete. Rather, transformation processes may go both forwards and
backwards, as the processes was reversed and the old forms were taken back in use. Thus, change was also only partial, since some of the emerged contradictions between the old ways of working and the new HMIS practices were not resolved, but continued to exist. From this study we can take a recommendation to critically examine the understanding and treatment of historicity in CHAT studies.
References


Kluschewski (Eds.), *Social thinking software practice* (pp. 287-308). Cambridge, Mass: MIT Press.


Appendix A: The Original OPD (Stroke) Form before the New HMIS

<table>
<thead>
<tr>
<th>DISEASES (WAKHANA)</th>
<th>MALE (WANAUIME)</th>
<th>FEMALE (WANAWAKE)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0-11 1-4 5-14 15+</td>
<td>0-11 1-4 5-14 15+</td>
</tr>
<tr>
<td>1. CHOLERA (Kipakaipindi)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. DYSENTRY (Kihara semi)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. GASTROENTERITIS/ DIARRHEA (Tumba la Kukanka)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. WHOOPING COUGH (Kibasam)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. TETANUS (Pepo per-ja)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. MEASLES (Shari)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. INFECTIOUS HEPATITIS (Kama ya Kini)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. CHICKEN POX (Tumikuru)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. MALARIA (Ngagiya ya Malari)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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|                  |                  |                  |
|                  |                  |                  |

PHC UNIT: CENTRE
PLACE
DISTRICT
MONTH: MAY
YEAR: 2005
NUMBER OF DAYS COVERED
## Appendix B: The First Version of The OPD Form (During the Design of the New HMIS) - With

<table>
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<tr>
<th>Diagnosis</th>
<th>Male</th>
<th>Female</th>
<th>N ≥ 5 yrs</th>
<th>R</th>
<th>N</th>
<th>R</th>
<th>N ≥ 5 yrs</th>
<th>R</th>
<th>N</th>
<th>R</th>
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</thead>
<tbody>
<tr>
<td>Diarrhoea</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anaemia</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaria</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OPD TALLY SHEET

Name of Health Facility:

District:

Month:
Appendix C: The Second Version of the Revised OPD Form (During the Design of the New HMIS)
- Without 00s

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Urinary Tract Infection</th>
<th>Diarrhoea</th>
<th>Pneumonia</th>
<th>Anaemia</th>
<th>Malaria</th>
</tr>
</thead>
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<tr>
<td><strong>N</strong></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td><strong>&lt; 5 yrs</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>R</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>≥ 5 yrs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OPD TALLY SHEET**
- Name of health facility
- District
- Month
APPENDIXES III


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ABSTRACT
In this paper we discuss two Participatory Design (PD) projects, one in Tanzania-Zanzibar and the other one in Sweden. In both countries the design process was done through the analysis of work practices involving both designers and users. The discussion focuses on a number of factors such as location, time and scene. We also ask how different projects can be that it is still possible to talk about PD as an overall participation and design approach. If PD is not a singular, definite, closed and fixed approach on the explicit layers, so how do these projects relate to each other when focusing on methods embracing the ambiguities of participation? The paper ends with a discussion of differences and similarities considering participation in the projects.

Keywords
Participation, work practices, methods, Tanzania-Zanzibar, Sweden, ambiguity, differences.

ACM Classification Keywords
K.6.1 [Project and People Management]: Systems analysis and design, Systems development. Design

INTRODUCTION
The aim is to juxtapose participation in two PD-projects carried out in different countries and organisations – the Tanzania-Zanzibar in a hospital and the Swedish in a number of municipalities. We are interested in mutual learning of local and situated interpretations and implementations of participation.

The questions we address are: what happens with the Scandinavian approach of Participatory Design when it travels? How does it keep its core ideas of (user) participation and how are the located and embodied ideas of participation transformed during the geographical, sociopolitical and technological journey? Does its strength actually lie in its capacity and ability to get translated and transformed, in its fluidity and ambiguity?

The paper is structured as follows. In the next section we discuss different forms of participation. This is followed by two sections where the Tanzania-Zanzibar and Swedish cases are presented. In the fifth part of the article we focus on the apparent differences of the projects in terms of locations, sociopolitical spaces, work practices and technological infrastructures. In the sixth part we discuss the difficulties linked to the ethnographic studies of work practices, relevant for both the Tanzania-Zanzibar and the Swedish case. In this discussion we suggest that the themes of knowing and skills could help us to widen the idea of users’ participation and contribution.

The paper ends with a discussion of participation by focusing differences and similarities.

WHOSE PARTICIPATION?
Visions of the future information system come into view very near the beginning of the design process; sometimes even before the present domain or situation is analysed [5] Designers’ as well as users’ ideas, values and understandings are intertwined with their visions of the choice of a certain functionality, structure or technology of the future system, service or artefact [4]. People’s visions, ideas and actions are rooted somewhere, thus, it means there exists “an underlying system shaping thought and practice.” [15]. Nevertheless, the imaginations of the world are not comprehensive but are situated and partial [14]. Situated knowledges contest the dominating discourse; design from nowhere, its space and preferential right of interpreting the world, by the creation of a competing discourse or position that consider design work as design from somewhere or located accountability [31].
The Scandinavian Tradition of Participatory Design
A critical or located design approach is the Scandinavian tradition of Participatory Design. The central issue of the tradition has been the user involvement in computer based systems design. The approach has had two trajectories: to participate and influence the democratisation of the working life by the involvement of prospective users but also to democratise the design process [2]. Eevi Beck’s [1] article P for Political Participation is not enough started a new discussion of PD when she argued for the necessity to recapture PD’s political dimensions. Susan Bodker [8], one of those who continued the discussion, argued for research-based participatory design alternatives since user quality matters. Research-based PD projects are alternatives compared to mainstream solutions constructed by large companies. Dan Shapiro [28] on the other hand suggests that the PD-community should challenge the development and implementation of IT in the public sector depending on the high percentages of failures. He advocates critical self-reflection and an experimental strategy as a way to build consensus within the PD-community, before making interventions.

Participation in Other Settings
In developing countries PD-approaches in IS/IT development have been discussed and used within limits [24]. Nevertheless, participatory and collaborative initiatives exist also in developing countries, such as for example the research and development program Health Information Systems Program (HISP) [24, 6] as well as the participatory approach Participating Rural Appraisal (PRA) [25, 27]. PRA has been used above all in rural settings but has in stages been extended to other sites as well as to research. The method has been used by a variety of actors from the World Bank to NGOs. However, the use of PRA has been criticised for using local community labour as a mean to reduce costs at expenses of empowerment [25].

The birth region of the Scandinavian tradition of PD is located in the Nordic welfare states, where participation often is understood as a mean of formal representative democracy and thereby also highly regulated. But the ideas of how to expand the notion of participation might be found also in other forms. The Sami people in the Nordic countries have an oral tradition. Depending on this tradition their use of land is not documented or they cannot prove with maps how they have used the land, which causes judicial problems in Sweden. From other parts of the world, such as in South-Africa [24] meetings (imbizo’s) are arranged for collective decision making and the Gacaca tradition in Rwanda as the traditional form of village courts.1 Thus, participation exists in a variety of forms.

THE CASE IN TANZANIA-ZANZIBAR
Zanzibar is one of the political entities constituting the United Republic of Tanzania. It consists of two islands, Unguja and Pemba. Zanzibar has considerable autonomy in her domestic affairs administered through the Revolutionary Council and the House of Representative. The health care sector is one of the domestic affairs administered separately from the Union government, although there are considerable collaborations with the health care sector in Tanzania mainland. The health care sector in Zanzibar is under the Ministry of Health and Social Welfare. This ministry is the responsible agency for health services in Zanzibar.

With a population of 984,625 inhabitants (2002 census2), Zanzibar is divided into five administrative regions, three in Unguja and two in Pemba. Each region is subdivided into two districts which make a total of ten districts for the Islands. The districts are subdivided into 50 constituencies, 29 in Unguja and 21 in Pemba. The constituencies are further divided into 237 shehias, 168 in Unguja and 69 in Pemba. The shehias are the lowest government administrative structure operating at the community level.

The Health System
The current health care delivery system in the public health care structure in Zanzibar has been divided into three main levels: primary level, secondary level and tertiary level. The primary level is the lowest level where there are most of the Primary Health Care (PHC) services basing on preventive services and promotion of health education. It comprises of the 1st line (PHC Units) and 2nd line (dispensaries) health facilities. The secondary level is the referral point from the primary level health facilities. It comprises of district hospitals (cottage hospitals and general special hospitals) of which offer curative services with little out patient services. The tertiary level is the last referral point for the health facilities. It comprises of Mnazi Mmoja hospital which is the only specialized hospital in Zanzibar, located in the Unguja Island. This hospital provides a full range of specialized services for both referral and emergency conditions. Parallel to providing health care services, Mnazi Mmoja hospital is also a centre for medical education and operates in semi-autonomous entity.

The Zanzibar health care delivery system has a number of sub-systems for collecting and reporting data. Health programmes such as Expanded Programme on Immunization (EPI), NACP, Malaria, TB and Leprosy have been introducing forms for collecting disease specific information at the PHC units and hospitals. These forms usually range from handwritten to printed formats.

The system of collecting information on diseases and related health services at Mnazi Mmoja hospital was introduced in 1968 when the Ministry of Health and Social Welfare established a Statistics Unit. Being a big hospital with 14 wards and 18 clinics, serving the majority of the population in Zanzibar, Mnazi Mmoja has experienced

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1 http://www.inkiko-gacaca.gov.rw/En/EnIntroduction.htm

2 http://www.tanzania.go.tz/census/regions.htm
problems in collecting and managing its health care data. The main problem was lack of standards in reporting from the wards and clinics. Some wards and clinics do collect health data and others do not. Even those who collect data do not have a standardized way of collecting, keeping and reporting those data.

In November 2004, the Ministry of Health and Social Welfare and all its stakeholders conducted a workshop to review the health management information system (HMIS) in Zanzibar. The result of the workshop was a need for improving the HMIS in Zanzibar which included improving the information system within Mnazi Mmoja referral hospital. These decisions embarked on a project known as the Health Information Systems Programme (HISP). This paper reports a participatory approach used by the HISP in redesigning the information system within the Mnazi Mmoja hospital. Since the implementation stage was about to start by the time to writing this paper, this discussion is limited to participation during the initial concept development and system configuration.

The work of HISP is to consolidate, reorganize and redesign the data collection tools into a standardized data management and reporting system. The main focus of this process is to create a system that can serve the following functions. **Routine:** data collection, processing and reporting is continuous and within the specified time period. **Functional:** the amount of information collected should be based on the need to identify problems and thus being able to respond quickly.

A task force from users was created consisting of the head of the HMIS at the Ministry of Health (MoH) who is a medical doctor by profession and works at the Mnazi Mmoja hospital, vertical programmes representative, representative of the Expanded Programme on Immunization (EPI), representative from the Planning unit, a representative from the Mnazi Mmoja hospital who is the head of the Statistics unit within the hospital, the head of the Statistics unit from the MoH, a representative from the AIDS control programme and representatives from the health districts (both Unguja and Pemba).

Designers’ team was formed consisting of professionals in research, programming, information systems in general and experiences in the implementation of health information systems in developing countries specifically. One of the authors of this paper is a member of the designers’ team.

**THE SWEDISH CASE**
Blekinge is a county in the southeast of Sweden. It is one of the many regions that were earlier dependent on the metal industry; and in Blekinge’s case, also on fishing and the military. During the last thirty years a great number of these branches have disappeared. Blekinge, as all similar regions with high unemployment figures, has been looking for new industries and new futures. One of the municipalities in this region, namely Ronneby, can be used as a point in case. Early in the 1980s, some municipal politicians had heard about the expanding field of the computing industry and especially about developments in software. In the beginning of the 1980s, the technology centre known as Soft Center was established. What later became the leading activity for almost the entire region was computers and information technology in general. The other municipalities in the region are striving in a similar manner to become economic, social and ecological sustainable in a changing world. In addition to the industrial and business development, Blekinge has been a base for many information technology projects e.g., school, library and health care projects. [10]

**A Project about e-Government**
The Swedish case is a research and development project with the title ‘From government to e-government: skills, gender, technology and learning’. The rationale for the project is that the Swedish public sector is in the middle of an overwhelming change process with strong political hopes of creating a good service society by the usage of information technologies (IT). E-government is the overall concept for the transformation process. The more or less explicit goals in the political documents seem to be rationalisation, efficiency and effectiveness of the public sector, thus, called a modernisation. At the same time the goal is also to provide qualitative services to the citizens.

However, the IT policies are rather silent about the processes of introducing and developing solutions integrating organisational and technological change. They also keep quiet about the agency of the employees of the public sector, their participation and development of the IT-based services, and also that the public sector is a dominating labour market for women. [26]. The increased introduction of IT will probably change the working conditions and practices radically for the civil servants. However, remembering from the earlier experiences of computerization there should be a great concern regarding how the skills and experiences of the civil servants could and should influence the processes which once again seem to have a taste of technical determinism and a strong belief on IT as a driving force in the modernization of the public sector [12, 22]. In the crossroads between possibilities and risks of the expanding IT-mediated society and working life the aim of this PD-project is to study and design processes connected to work practices and IT-development in the public sector with a special focus on the participation of the civil servants.

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3 The design team consisted of 5 locals, 3 from South Africa who came as consultants due to their experience from the HISP project, two from Norway.

4 Two of the authors are involved in the project.
METHODS OF PARTICIPATION
Redesigning the Work Practices for the Mnazi Mmoja hospital: A Participatory Design Approach

In Mnazi Mmoja hospital the designers’ team through one medical doctor and the head of the Statistics unit from Mnazi Mmomoja hospital (members of the task force) managed to have access to other doctors and nurses in the wards and clinics. After the identification of the members of the task force the design process used may be divided into six main steps of which the last three steps were recurring. First, a meeting between designers and members of the task force whereby the designers described the importance of improved HMIS in general and the hospital information system in specific. This description was followed by an explanation of the design and implementation process at hand. We (designers) explained what we would like to know from the users work practices.

Second, users described the current work practices whereby they identified existing tools and artefacts being used for health care data collection and storage in all the wards and clinics. Parallel to how data is being collected, the users identified communication channels and destinations for the collected health care data, that is, where the data has to be reported within the hospital and outside the hospital, see Fig. 1.

![Diagram](image)

Figure 1. Data collection and information flows in Mnazi Mmoja hospital

To enable users to continue providing health care services to patients, this step took place within the hospital in respective wards and clinics. The representation of the work practices involved the descriptions of situations that users’ find important in their work, situations (activities) are currently constitute a bottleneck and needed to be changed or modified.

**Designer:** “Are you using all these data you [users] are collecting? [For example one clinic had recorded more than 50 diseases whereby some diseases had one patient in a year.]”

**Users:** “We use some of them ... among those diseases recorded [for some there are at least 10 common diseases].”

**Designer:** “What if we group those uncommon diseases into a category called others.”

On our side (the designers’ side) the representations of work pointed out to whether the kind of technology we were considering might potentially support the work in question, and how well to design the technology to be able to support the work in question.

Most of the data collection forms were not standardized. Each diagnosis was hand written by different doctors in different spellings although from the same ward for instance. Therefore, in the third step, the designers together with a doctor and the head of the statistics unit from the Mnazi Mmoja hospital who has experience on what diagnosis they attend at the hospital and what are their specific spellings created forms with correctly spelled diagnosis.

**User:** “We have a book called the International Classification of Diseases with the correct spelling of most of the disease. But it is from a long time ago [published in...] and some diseases are not there.... we also attend diseases which are due to the local environment and activities. These [those not in the book] we need to discuss with the incharges of the respective clinics and wards.”

As a preliminary stage these forms were created using Excel sheets. In the fourth step, forms were printed and distributed to the specific wards and clinics for testing whereby the health workers were asked to use the forms for data collection and reporting and then give recommendations on what is missing and how well the forms should be improved. The form distribution was done by the head of the Statistics unit from the task force who was also responsible for getting the feedback from the health workers and thereafter discuss with the designers.

**User(s):** “Other clinics have common diseases more than 10. It would be better if the forms are designed in such a way that there are empty rows at the end of the forms so that we [user] can add (writing by hand) more diseases which are not specified in the forms.”

**Designer:** “If users will write by hands then there will be not standardization of the diseases. It is better each ward and clinic with more diseases to indicate them so that they can be specified in the respective forms.”

While testing the forms, we started the fifth step which is configuring the District Health Software (DHIS) to meet the specification and requirements of the Mnazi Mmoja hospital. The software module was being demonstrated to the task force which included major stakeholders (DANIDA) who also funds the HMIS design project. The

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6 DANIDA, Danish International Development Agency.
sixth step involves redesigning the forms to incorporate the users’ suggestions. In the first testing session users added more common diseases which were not specified in the forms. The second testing session involved reducing the number of patient’s age categories on each disease being recorded. The age categories for the data collected from the clinics were <1, 1-4, 5-14, 15-17, and 18+ for females separated with males. The discussion with different clinics regarding the importance of each age category compared to the national population data categorization resulted into a categorization of < 5 and >5 for some clinics while leaving other clinics with <1, <5, 5+ and >15.

**Designer:** “Do you use all these age categories?”

**User:** “…”

All users told they do not use all age categories. Some did not even know why they collect those age categories. Others said that they are collecting them because some people from different organisations (usually NGOs) come to them (users) looking for those data.

Let this short re-visit to the initial phase of the project summarise the guiding principles for the exercise of participation:

- Simple, cheap and familiar tools for all participants
- Open entrance – no specific pre-determined focus on e.g. technology
- Not requiring time consuming preparations
- Inviting to and allowing collective exercises of participation – focus on the team not on the individual person
- Talking by doing – creating trust through a non-formal and open dialogue of the everyday life of the participants

**The First Workshops**

The participants in the workshops were, in addition to the two researchers⁷, a number of civil servants in four municipalities in the region of Blekinge. The participants were invited and encouraged to create a collective map/collage of their physical work place on a big white sheet. The creation was done as a collective exercise where the research participants facilitated material such as cutting images (people, furniture, technical artefacts), coloured paper, scissors, tapes, catalogues with pictures of desks, computers, binders etc. for creating ‘maps’ (see Fig 4). The map making also demanded discussions between the civil servants and the researchers of what should be included and not on the map, asking for support and help, commenting each others contributions, chancing ideas of what is important and what is not. So the maps were shaped as a co-constructive activity.

After the basic map was created the civil servants continued their cartographic exercise by including the most important relations in their work practices, which could be with their fellow colleagues, other employees at the municipal office, 

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⁷ Gertrudes Macueve, PhD student at University of Oslo participated in the first part of the workshops.
representatives from other companies, politicians, citizens as well as with artefacts (telephones, computers, printers, e-mail, fax, web pages, post-it notes, maps, rules and regulations, digital assistant, paper based brochures and so on).

Figure 4. A collective map

In situ interviews, or preferably dialogues or just talk, were closely enwove in the mapping activity, providing an easy access to relevant topics as presented by the civil servants and also an uncomplicated and informal way for the research participants to talk and ask clarifying questions and discuss.

The researchers had also created a variety of scenarios in advance based on their experiences and imaginations of day-to-day situations in the employees' work practices. The scenarios consisted of telephone calls, web inquiries, personal visits made by citizen X living in the actual municipality. A number of scenarios were performed as a role game as one additional way to get insight/understanding and to follow the traces of human and nonhuman actors in the work practices as for example: “Hello, I and my family have recently moved to this town. Now we are wondering if there are any afternoon activities for children?” “Hi! It’s absolutely devastating that children on their way to school have to take their bikes to the big road. How should I proceed if I want to suggest a new bicycle lane should be constructed?”

The Second Workshops

The following workshops were based on the civil servants’ own ethnographic exercise. In order to test experience based ethnography a number of disposable cameras were delivered to the workshop participants to develop further the idea of collective maps of their everyday work. The aim was both to visualise further the work routines for the participants themselves but also to give further clues and ideas for our situational process approach. Based on our earlier experiences and also referring to the ideas of testing and developing forms of participation we were convinced that when walking through with cameras and taking photos closely connected to the working environments and practices it was essential that it should be done by the experts of the everyday in focus, namely the civil servants and not the research participants. Participants from each municipality received two cameras each. The period for photographing was limited to approximately 2-3 weeks depending on how the date for the next coming workshop was negotiated.

The structure for the second workshops with the project participants was the same: have a complementary look at the workplace maps, browse through the photos (which were developed and printed during the weeks between the first and second workshop), choose and then place the most important ones of them on the map. Finally, to have a specific thematic discussion in each location based on the analysis of the first workshop session map. The introductory workshops were concluded by starting to think and to imagine of relations, connections, contacts and cooperation. In one case the dominating theme was the performance of gender in a male dominate sector, while in another case the implementation of the digital assistant or the relations between people and technology appeared to be a leading theme when thinking of important relations and communication at that specific work place.

EXPLICIT DIFFERENCES BETWEEN THE PROJECTS

When bringing the Tanzania-Zanzibar and the Swedish projects together the most explicit differences were connected to participation, scene, location, and technological skills.

Participation

In the Tanzanian case, due to the nature of the health care work and lack of human resources within the health care system the participants were working, the designers had to follow users in their working environments. Most of the time interviews and discussions had to be rescheduled to fit the participants’ time. The Mnazi Mmoja hospital is a referral hospital therefore many patients from other small hospitals come to this hospital. Sometimes the health workers have to give priority to emergence cases instead of the project even if we had agreed to meet. One health worker expressed:

“Today there has been an accident and therefore the doctor in charge is in the theatre room and he is the one who can tell you in specific what diseases are most common. We [the nurses who were there] will give him your [designers together with the head of the hospital Statistics unit] message.”

To participate in the Swedish project was taken for-granted. A number of local factors helped to create a smooth acceptance; such as the physical distance as almost non-existing in a small region such as Blekinge, and the mental closeness being tight between the municipalities and the university – most of the municipalities have experience of working in R&D-projects and one could almost claim that there is a quiet agreement that co-operation with the university is important both for the region and the actual project partners.
Scene
The Tanzania-Zanzibar case was carried out in a hospital in the public sector as a part of the HISP project, a large-scale program. On one hand the organisation is hierarchical with strict boundaries between the professionals both within the individual clinics, individual wards and within the hospital as a whole. This resulted in the fact that every time the designer(s) needed to have access to the in charge of the wards and clinics, the head of the hospital Statistics Unit had to coordinate. On the other hand the IS was implemented very recently and only a few health workers had used IT earlier. In the Swedish case a number of municipalities in a low populated region are involved, the project is low-scale and limited to the involved units compared to the Tanzania-Zanzibar case. The involved civil servants had been using IT in many years

Location
The most apparent difference between the two projects is of course the geographical. One of the projects was conducted in Africa (Tanzania-Zanzibar) and the other one in Scandinavia (Sweden-Blekinge). But what do these locations mean if we consider them as sociopolitical spaces? Tanzania-Zanzibar being a developing country has been putting efforts in improving its public health care through increasing access to health facilities. However, Tanzania-Zanzibar apart from having a short history of using information systems as compared to Swedes, it also has a short history of computerization in the working life. Together with the human resources, the technical infrastructure is limited. Health workers are lacking even simple calculators for totalizing the number of patients attended in a particular month. This results in time consuming job and error prone results. In Sweden the political ideology, known as ‘folkhemmet’ [13], has been the ruling social democratic ideology in Sweden since the Second World War. The main characteristic of the ‘folkhemmet’ ideology has been to build up a strong welfare system that guarantees social benefits. During the 1970s new working life legislation was carried out, which enforced the position of the employees in the decision making bodies. The ground of participation is politically grounded and also formalized. [9]

Technological Skills
Computer skills are wide between Tanzania-Zanzibar and Sweden. Due to the stable technical infrastructure, on-going computerisation and automatisation in the working life in general, and also to political initiatives aimed to promote access to technology (e.g. tax reductions and free access to the Internet e.g. at public libraries) have provided time and opportunities to get familiarised with IT. There is hardly anyone in Sweden who has not experiences of a variety of IT-implementations. The story is quite contrary when we change the scene and analyse the access and familiarity issues in Tanzania-Zanzibar. The lack of basic computer skills and as a result experiences of IT-use are hardly existing [17].

Currently no taxes on importing computers in Tanzania which has reduced the prices and therefore many people are now starting having computers for home use. However, since this is a recent initiative people are still lacking computer skills. Another reason is the poor electricity infrastructure which limits the use of computers in different organizations especially those in remote areas - hardly to find a computer in a rural hospital. The improvement in using computers due to the current policy of removed taxes takes place in towns and big cities with electricity.

From Differences to Similarities
The discussion above stresses the apparent, clear and obvious differences so it might seem as if we were comparing apples and oranges. But the both cases take their starting points from the Scandinavian tradition of PD; namely from the wishes to involve users, to understand work practices, to situate and locate design, and to respect the democratic principles of participation.

These similarities construct PD as a boundary object [29], in the meaning that through the similar core ideas the projects are not only tied together, but also connected to the shared PD-approach. So the sameness is there. At the same time we now know that the differences are also there. PD seems at the same time to be something fixed and fluid. John Law [18] suggests the concept of fractional objects for phenomena that are successful just because they can change their shape by being fluid. The conclusion is that it is the richness and multiplicity that will keep PD alive and that also makes it richer and stronger. PD has become ‘more than one but less than many.’[18].

We take the concept of fractional objects with us, when we move from the discussion of differences towards participation as a resource for the development of PD. In order to do this we re-visit our individual projects.

HOW TO KNOW ABOUT KNOWING?
Many of the PD-projects have been and are still located in the working life, such as in our case at a hospital and in a number of municipal offices. A sincere development of work practice sensitive methods has been one of the corner stones in the history of PD. Especially ethnographically oriented methods, such as interview and observation, have been used when trying to capture the richness of the everyday work. In general, the ethnographic studies within the PD-projects have been placed in the initial phases and conducted by the initiative of the design partners of the project.

In Tanzania-Zanzibar participation was done through interviews, observations, individual and group discussions. Based on the hierarchical nature of the working environment, the head of the statistics unit had to organize all the interviews, go with the designers ward by ward,

8 People's home [Our translation]
clinic by clinic for observations and some group discussions. The initial design work involved these ethnographic methods in order to understand the conditions and work practices within the hospital. However, unlike traditional ethnographic methods the work did not end in understanding the setting and the work practices, but the methods were used through the design process for making improvements in what was being designed. This was mainly during the testing phase of the design process.

In most of our design work, we adopted the role of participant observers, finding ourselves becoming part of the hospital context through activities such as going with the head of the statistics unit ward by ward collecting the monthly data. This role helped to research the data collection and reporting process and creating a working monthly data. This role helped to research the data the head of the statistics unit ward by ward collecting the data. The challenges lie partly in the role of participant observers. Group discussions were done when we exercised the role of participant observers. Group discussions were done through meetings between designers and users.

However, using these methods was not free of challenges either for designers or users. The challenges lie partly in setting up meetings due to the busy schedule of health workers. For example it was not possible to have two meetings for group discussions with people having the same work. The other challenge was in defining courses of action in the design in cases when there were multiple perspectives and suggestions from the health workers. Whose perspective and suggestions should be designed in the system? In dealing with this challenge we had to extend our discussions and point out to the importance and strengths of one suggestion over the other. This was possible with the help of the heads of the statistics unit and the hospital matron who has experience in most of the hospital issues.

Despite these problems we still used ethnographic methods due to the following reasons: Considering the fact that the HISP project (together with its accompanying software – DHIS) is a research and development program which originated from South Africa, ethnographic methods provides us a valuable tool for developing the HISP and DHIS for local adaptation. Another reason is due to the busy working environment of health workers these methods helped us to us participatory design at the same time allowing health workers to continue with their work.

There is no doubt that questions concerning methods of the user participation have been widely discussed and developed during many years within the PD-community. We have seen methods growing from experiments and later on finding their place in the method cupboard: games [3] probes [19] ambiguity [11], photography and video filming as extended tools for ethnographic studies [32] and a number of other visual techniques (freehand drawing, and dead sea scroll) [7]. The common feature for these methods is to obtain ‘first hand experience with present work practices, technological options, or a proposed new system’ [7 p. 246]. In spite of the powerful idea of connecting the design phases to the present work practices and inviting users to participate there is still room for critical questions.

**Are Ethnographic Methods Really Enough?**

The practice and experience based aspects of knowledge and knowing are not directly observable for ethnographers since they are not knowledgeable experts of experiences and practical skills in focus. On the other hand, to articulate practical and experience based knowledge in words, is not a simple task for the practitioners either [see e.g. 21, see also [23] for a discussion of silences]⁹. This has been on going discussion in the PD communities but the question is still of importance: How to sensitise the work practice oriented methods to enhance the tacit knowledge? What are the practitioners’ own ethnographic methods, and what is the role of the expert ethnographers is a question occupying the researchers in the Swedish project.

The implicit starting point when using interview and observation is that knowledge, knowing and skills are something that can be captured even by an outsider - the ethnographer - and/or something that can be put in words and talked about. [see e.g. 7]. However, when linking ethnographic methods and work practices together with knowing and skills (knowing and knowledge in practice), we step aside the visible, explicit and articulated aspects of knowledge. The focus shifts to the direction of experiences and the tacit aspects of knowing and skills. How to face the problem is not in the PD-community important (only) as an interesting epistemological question. But mainly it is a demanding methodological challenge because at the end the issues of knowing and skills get linked to the design issues: “How can the invisible knowledge, experience... be articulated and integrated into technology design?” [16, p. 36]). In earlier projects, with the special focus on tacit knowing, a story telling method has been tested but in the actual project the method was not applicable due to the time limit.¹⁰ In the Swedish case the aim was to avoid ‘methods of words’ but instead in a higher degree visualise the work practices by the civil servants themselves.

**Embracing Ambiguity**

Susan Leigh Star and Anselm Strauss [30] raise, however, an ethical question of invisible and silent knowledge: Is it always wise from the perspective of the professional people to uncover their skills? Or might we risk something when we add aspects of power and status in the analysis? With an

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⁹ The statement is also based on the recent projects with a number of employees at a call centre and a job centre conducted by one of the authors.

¹⁰ The earlier projects with the staff at a call centre and a job centre were conducted as a continuous series of seminars during appr. 6 months.
example from one of the Swedish workshops we will illustrate tacit knowledge and silence:

We are laughing and talking. One of our participants is telling a wonderful story from her everyday work. One citizen visited her. The woman was behind with the payments of day nursery. She wanted to pay in cash but the system did not accept any real money. So the civil servant said to the person: “Let’s go together to the bank. Then I’ll see that you fix it and I get a receipt. When I go back to the office I register your payment. After that everything is in order”. And they did it, thus, marched together to the nearby bank. Everything worked out smoothly. And everybody was happy: the citizen (she could pay the fee for day nursery and not end up in the enforcement register), the civil servant (she could do her job and get in the expected fee) and the municipality (they got their money). Then (Pirjo) asked that couldn’t the citizens use the municipality web site to check their taxes and other fees. Hence to develop a self service municipality? And we started to make fantasies or scenarios. And suddenly I heard the civil servant who sat next to me, she said, very, very silently: “But then Anna (referring to the civil servant working with the municipal fees, sorting them, posting the payment forms, reminding etc) will get unemployed??” (From the research diary).

When we open up the questions of knowing and skills we might end up in ambiguities giving a feeling of uncertainty when one has to deal with fuzziness and fluidity that cannot be interpreted and compromised in a one single linear and rational story supporting design [18]. However, if we really take the PD-core ideas seriously, fuzziness and fluidity are not anything we should work away from. Instead we should ask how to keep them alive in PD-projects. So the key question becomes how to talk and exercise participation that enables and allows different realities, experiences and knowledge.

DISCUSSION
Participation and its various forms have been reported through the two cases. The prerequisites differed in terms of location, scene, and technological skills. Nevertheless, it was possible to create space for agency for those involved in the projects. Hence PD’s and particularly the Scandinavian tradition’s strength actually lie in its capacity and ability to get translated and transformed; in its fluidity and ambiguity.

While the differences were obvious the similarities were more ambiguous. But by discussing methods, we could address the question of skills, qualifications and knowledge and also the question whose knowledge dominates; the user or the designer/researcher. Then the similarities appeared more obvious. The original idea of PD was to develop tools and methods to support the mutual co-operation between different groups of expertise, but it still kept the skills and positions of designers and users separated.

The lessons learned through juxtaposing the two cases are that participation and how to participate has to be negotiated and adapted to the local setting. Sometimes we can renegotiate the relations between the designers and the users like in the Swedish case and sometimes the mutual cooperation demands separation of designers and users like in the Tanzania-Zanzibar case. Thus, the designers seem to dominate in the Tanzanian-Zanzibar case compared to the Swedish. On the other hand the users were not a uniform group; some dominate more than others. Users from the Mnazi Mmoja hospital can be categorized into two groups: health practitioners and the head of the statistics unit. When health practitioners were busy and we (designers) could not get them to make decisions, the head of the statistics unit made decision on the particular issue.

So there are no universal answers to the ongoing discussion about the relationship between designers and users [see e.g. 20]. But the question to be asked in all PD projects is: How can the dominant notions of ‘relevant expertise and views’ be challenged? [16, p. 36] This is the only way to keep PD’s idea to create trust, openness and to give room for participation.

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Agency as Embedded in an Organizational Context: A Case of Hospital Management Information Systems in Zanzibar

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Abstract

Studies on the relationship between organizations or societies and technology have centered on the relationships between particular agents, their actions and the consequences of the actions. Consequently, researchers use, explicitly or implicitly, some conceptualization of agency when studying systems design, implementation and use. Yet, there is not a coherent and well-established theoretical framework for studying agency. Moreover, the empirical evidence of how agency is enacted and of the driving force of that enactment is somewhat limited. Using an ethnographic research approach, this article presents a study on the design and implementation of a computerized hospital management information system (HMIS) in Zanzibar. The study explores how participants negotiate agency, how their agency shapes and is shaped by the temporal relational context of action and technology materiality and, thus why actors act in certain ways during systems design and implementation processes. The study is used to develop some implications on systems design and implementation processes.

Keywords: Agency, systems design, organizational context, organizational transformation

1. INTRODUCTION

The relationship between societies and technology is one of the most important issues within both social theory and technology studies (Fleischmann, 2006). Over the last two and half decades, researchers have offered various conceptualizations of this relationship (Boudreau & Robey, 2005). The researchers' position have impact on whether they consider technologies as capable of shaping a social organization and human behaviors, or whether humans within the organization are capable of shaping the way technologies can be used (Markus & Robey, 1988).
Other researchers have focused on the interplay between humans and technologies as shaping each other (Rose & Jones, 2005). Despite the different standpoints, any study on the relationship between humans and technology within organizations will necessarily entail a conceptualization of the relation between actors, actions and their consequences, which Rose et al. (2005) characterize as the issue of agency.

An agency perspective raises important issues regarding organizational transformation through the implementation of information technologies (IT) and information systems (IS). While various conceptualizations have been proposed, researchers “have focused either on the technology and ignored the influence of human agency, or on social interaction and ignored the technology” (Volkoff et al., 2007, p. 832). Consequently, Orlikowski and Barley (2001, p. 158) advocated for more research “that embraces the importance of simultaneously understanding the role of human agency as embedded in institutional contexts as well as the constraints and affordances of technologies as material systems”. It is within the agency perspective that this paper intends to contribute towards addressing the relationship between humans and technologies. While also incorporating the material aspect of technology, we focus on how participants negotiate agency, how their agency shapes and is shaped by the system design and implementation process and why they act in certain ways. We are particularly interested in the co-construction of human agency and interactive artifacts. The aim is to develop some implications on systems design and implementation processes.

We present examples from an ethnographic study conducted on the design and implementation of an IT based IS within hospitals in Zanzibar. The utilization of IT within health care organizations has taken different directions in both developed and developing countries (Ranganathan et al., 2004). Technological advancements in the form of enterprise resource planning applications, electronic patient records and clinical applications have spurred many health care organizations to use IT as an engine for organizational transformation. Yet implementing IT systems in public health care organizations in general and hospitals in particular can be challenging. Observed challenges range from infrastructural and technological barriers to health workers’ determination that patients, not processes, remain the foremost priority (Sahay, 2001; Littlejohns et al., 2003; Ranganathan et al., 2004). Moreover, health care organizations also face special challenges due to the heterogeneous number of stakeholders; inside and outside the organization, located locally and globally, with differing objectives that can lead to prominent conflicts of interests (Harding & Preker, 2000). In this regard, health care organizations present a rich area for studying how agency is enacted during systems design.

The study develops a theoretical framework that integrates the elements of the temporal theory of agency (Emirbayer & Mische, 1998), technology materiality and context to provide a more
fine-grained analysis of how time, technology and context interact in shaping systems design and implementation processes. Although Emirbayer and Mische’ used prior studies to explain the components of the temporal theory of agency, not much empirical work exists which serve to test and further build the theory (Cousins, 2004). The temporal theory of agency proves valuable in our analysis because it helps in explaining agency as a social and relational process by and through which actors immersed in temporal contexts engage with others to produce a collectively organized action.

The paper is organized as follows. Section 2 presents a frame of reference and the theoretical perspectives used to analyze the empirical findings. Section 3 provides a background of the study area and a description of the data collection methods. Section 4 describes the empirical findings. Section 5 is the discussion and analysis of the empirical findings. The paper draws some theoretical and practical implications from the study in section 6.

2. AGENCY IN TRANSFORMATION PROCESSES

Researchers studying changes in practice are attracted to theories of agency in explaining the relationship between humans and technologies (Chu & Robey, 2008). Dominant discourses have traditionally understood this relationship in terms of technological and social determinism (Markus & Robey, 1988). In technological determinism, technology is viewed as something that can embody rules, guide action, limit choice alternatives and monitor human action in the process of organizational change (Zuboff, 1988; Huber, 1990; Kimble & McLoughlin, 1995). In the social deterministic account, human actors are seen as having unlimited control over technology and its consequences (Kimble & McLoughlin, 1995). For a detailed discussion on dominant discourses on the relationship between humans and technology see for example, Markus and Robey (1988) and Fleischmann (2007).

The extreme positions of technological and social determinism are, however, inadequate to provide an account of the mutual relationship between the social and technical aspects of changes in practice. Building on process-based approaches to change, theoretical perspectives which are less deterministic were developed to address the shortcomings of the two extreme positions on agency. Among others, these theoretical frameworks include Giddens’ (1984) structuration theory, actor-network theory (ANT) (Latour, 1987; Callon & Law, 2005; Latour, 2005), feminists studies in general and specifically feminist science and technology studies (Haraway 1997, 2008; Barad 2007, Suchman 2007), and Pickering’s (1995) notion of the mangle of practice.

Studies using structuration theory argue for the mutual shaping between agency and structure (e.g. Orlikowski & Robey, 1991; Orlikowski, 1992). While agency is enabled or limited by
structure, structure is produced, and reproduced by the actions of humans in social contexts. This emphasis on mutual shaping can be seen as offering an alternative to technological or social determinism (Markus & Robey, 1988). While this perspective may be appropriate for conceptualizing social structures that have no concrete form, it ignores the material aspects of the technology (Volkoff et al., 2007). Technology is seen as having no agency of its own, except as implicated in the actions of humans in their social practices (Rose et al., 2005). As a result, structurational treatments are seen to privilege human agency over technology agency.

Studies using an ANT perspective (e.g. Monteiro, 1998; Aanestad, 2003; Elovaara, 2004) have also emerged where, humans and non-humans such as IT artifacts, animals, plants etc. are equally endowed with the power to act. Organizational change entails examining the process of negotiation whereby different actors (humans and nonhumans) work to enroll each other as allies, and through which their interests are translated and become aligned (Law & Hassard, 2006). However, according to Volkoff et al., (2007, p. 834), “ANT offers a high-level explanation based on negotiation, but fails to capture the active role of technology in negotiation.” In this process, “technology is viewed as a receptacle where an actor’s perspective can be inscribed and frozen.”

Feminist researchers explore agency in various practices with a focus on the power to determine and act in practices (Messer-Davidow, 1995; McNay, 2000). Further, agency is also in focus in feminist science and technology studies through agency as a relation between humans and nonhumans (Haraway 1997; Barad, 2007; Suchman, 2007). For example, with an exploration of Robert Boyle’s experiments with the air-pump, Haraway (1997) discusses the experimental way of life or science in-the-making. She concludes that gender is also intertwined in-the-making as well as the devices. Haraway writes:

The air-pump was an actor in the drama of the Scientific Revolution. The device’s potent agency in civil matters and its capacity to bear witness exceeded that of most of the humans who attended its performance and looked after its functioning (Haraway 1997, p. 42).

The boundaries between human and nonhumans is one issue which also concerns Pickering (1995) who uses the notion of the mangle of practice to argue for a view of agency which is not entirely symmetrical as it is in the ANT perspective. In Pickering’s view, humans and nonhumans are seen to exhibit different influences and contingences, and both are emergent from ongoing practices. Pickering argues that, scientists, as human agents, maneuver in a field of material agency, constructing machines that capture and control that agency. In this regard, agency is a reciprocally transformative process that takes place back and forth between human and material performances. However, the agency of nonhumans differs from human agency.
because it lacks intentionality.

In summary, there is a general acknowledgement that both humans and nonhumans agency play an important role in changing practices, regardless of which side their distinction begin or on which side they end up (Leonardi & Barley, 2008). However, extant literature has indicated that, theories of agency have ignored the context in which agency occurs (Howcroft et al., 2004; Boudreau & Robey, 2005). While studying the influence of individuals and group preferences is helpful in its own right, it is also important to recognize that these individual and group preferences do not arise from 'thin-air'. "Rather they are a product of (as well as contributing to) the particular organizational context" (Howcroft et al., 2004, p. 272). An account of the contextual influences on action explores how and why participants act as they do during the change process. The challenge then is to develop a theoretical understanding that may help us address the entanglement of the technology and the social (Orlikowski, 2005) without allowing the contextual influences to vanish from view. In our case, we have chosen to recognize and learn from the temporal theory of agency which we describe in the following section.

2.1 The Temporal Theory of Agency

Theoretical writings that increase our understanding of agency have appeared within the sociology field (e.g., Emirbayer & Mische, 1998; Fuchs, 2001; Côté & Levine, 2002). While traditional sociological explanations view institutional structure as the cause of actions (Boudreau & Robey, 2005), much of the recent discussions focus on the empirical conditions of agency: how and when agency is possible and about ways in which the phenomenon of agency can be conceptualized and theorized (Biesta & Tedder, 2006). One example is an account of what is agency by Emirbayer and Mische (1998), which forms the basis of the theoretical framework for this paper. We believe that such an account addresses how agency is intertwined with the organizational context. It gives us an opportunity to explore how action emerges or not emerges within a hospital when designing and implementing an IT based IS.

Emirbayer and Mische view agency as involving the capacity to both sustain and transform structures and they define it "as the temporal constructed engagement by actors of different structural environments – the temporal-relational contexts of action – which, through the interplay of habit, imagination, and judgment, both reproduces and transforms those structures in interactive responses to problems posed by changing historical situations" (p. 970). They analytically distinguish three constitutive elements of agency as *iterational, projective* and *practical evaluative*. These elements allow the examination of actions that are more oriented towards the interplay of the past, the future and the present.

The *iterational* element of agency is manifested in actor's abilities to recall, select, and
appropriately apply the more or less tacit and embodied experience and knowledge that they have developed through past interactions in an organization. The agentic dimension lies in how actors selectively recognize, locate, and implement such experiences and knowledge in their ongoing and situated interactions. In this case, social actors not only identify similarities between past and present experiences and knowledge but also locate these differently in relation to other persons, contexts, or events within an organization. The projective element focuses on actors’ capacities to imagine other possibilities than those at their disposal. Rather than merely repeating past routines, this element of agency reflects the potential of actors to transform their work practices. The practical evaluative element responds to the demand and contingencies of the present. It entails the capacity of actors to make practical and normative judgments among alternative possible trajectories of action, in response to the emerging demands, dilemmas, and ambiguities of the presently evolving situations. With the chordal triad of agency the interplay between the three elements is emphasized although in any given case, one or another of these three constitutive elements might predominate; an action can be more (or less) related to the past, more (or less) directed toward the future, and more (or less) responsive to the present.

In addition to aspects of the three elements, Emirbayer and Mische emphasize that, all social actions are a concrete synthesis, produced, created and conditioned by the temporal relational contexts of action and what people do. In this regard, agency is “always a dialogical process by and through which actors immersed in temporal passage engage with others within collectively organized contexts of action” (ibid., p. 974). Hence, Emirbayer and Mische’s temporal agency is relational (see also Suchman 2007); the actors are located in the situations and agency is located in the situation as well.

The application of Emirbayer and Mische’s conceptualization of agency can be found in recent studies on changes in work practices following the adoption of IT based systems (e.g. Chu & Robey, 2008), users’ enactments of newly implemented IT based systems (e.g. Boudreau & Robey, 2005) and patterns of technology use (e.g. Cousins & Robey, 2005). While the main focus in these studies is on technology in use, our analysis focuses on how agency is enacted during technology design and implementation processes within hospitals in Zanzibar.

### 2.2 Theoretical Framework for the Analysis of Empirical Data

Our empirical analysis begins with looking at the three elements of agency: *iterational, projective* and *practical evaluation* (Emirbayer & Mische, 1998). We examine the relationship between participants’ actions in terms of the interplay between habits, imaginations, and judgments during the Health Management Information Systems (HMIS) design and implementation process. Moreover, in analyzing the findings, we consider the following.
Empirical social action will never be completely determined or structured. (ii) The context does matter in ways agency is enacted. That is, organizational context has impact on action. In this regard, agency is not a possession, and particularly not an individual's possession, but something that is achieved in action with other actors (human and nonhumans) and the context in which the action takes place. Therefore, actors do not act in isolation but their actions crucially depend on others and the ways in which others respond to their actions and initiatives (ibid).

(iii) Moreover, Chu and Robey (2008) argue that Emirbayer and Mische’s account of agency may be criticized for its inadequacy in addressing the role of technology in social change. However, we find their account leaving open the possibility for addressing both humans and nonhumans agency. We argue that actors’ past, present and future aspects of practices include technologies used (in use) and contextual issues. In this regard, in our use of the three elements of agency we pay a particular attention to the interplay between agency, technology and context.

3. CONTEXT, SETTING AND RESEARCH METHODS

This section provides background information to locate the Hospital Management Information System (HMIS) design and implementation activities within the context of Zanzibar’s health care organizational transformation prior to and during the study period. This background aims to provide a better understanding of the broader context of events in the empirical findings, which are provided in the next section. Moreover, the section describes the research methods used to gather the empirical material.

3.1 Hospital Management Information Systems in Zanzibar: Background

Zanzibar has made considerable efforts in improving the coverage of health care services infrastructure after the revolution in 1964 (Ministry of Health and Social Welfare Zanzibar, 2002). This achievement is the result of the health sector reforms as stated in the Alma-Ata declaration (1978). The current health care delivery system within the public health care structure in Zanzibar has three main levels: primary level, secondary level and tertiary level (Figure 1). The primary level is the lowest level comprising of primary health care units (PHCUs) and primary health care centers (PHCCs). At this level, health care services are mainly preventive measures, promotion of health education and little in-patient services (specifically at the PHCCs). The secondary level is the referral point of the primary level health facilities, comprising of district hospitals. In addition to services provided by the primary level health facilities, district hospitals offer curative services. At the tertiary level, there is a specialized hospital providing a full range of specialized services for referred and emergency conditions as well as working as a centre for medical education.
Each PHCC, district hospital and the referral hospital consists of different wards (for in-patients services) and clinics (for outpatient services). Wards and clinics are the sources of health care data, through which doctors and nurses attend patients and record the patients’ information in hand drawn register books on daily basis. At the end of each month, the data collected in the register books is summarized into a monthly report in a paper form and reported to the statistics department. The statistics department is ideally a section within each hospital responsible for the distribution of data collection tools to all wards and clinics, collection of reports from the various wards and clinics, preparing an overall hospital report and submitting the report to the Ministry of Health (MoH) (see Figure 2).

Despite the improvement in health care infrastructure the country continues to face high burdens of diseases such as malaria, tuberculosis (TB) and leprosy, HIV/AIDS and other communicable diseases. To address the burden of diseases, several disease specific programmes, mainly supported by donor agencies were initiated. In order to cater the needs for health care data these programmes introduced paper forms for collecting disease specific information. As a result, the health care delivery system had a number of sub-systems for collecting and reporting data. The introduced forms ranged from hand written to printed formats. A drawback of the handwritten forms was variation in the spelling of diagnoses names, which based on the understanding of the health worker who is using the form. Due to the existence of multiple systems, health workers within the wards and clinics were faced with high workloads resulting from demands of data from various departments, management and other health care stakeholders. Furthermore, some of the data collection tools did not meet either the hospitals information needs or the information reporting requirements. This was obvious especially when there were changes in the services to be provided in terms of new diseases and
new introduced medicines or an increase in the number of patients with a specific disease in a particular season.

Thus, hospitals experienced problems in collecting and managing its health care data. The main problem at the referral hospital was lack of standards in reporting from the wards and clinics and therefore no systematic overview at the hospital level of the basic indicators for management, such as bed occupancy rate and death rate as well as lack of reports on diseases surveillance. Figure 2 presents the fragmented health care data flow (as for the period of 2001 to 2005) within and between the referral hospital and the MoH and vertical programmes.

**Figure 2: Health care data flow within hospitals in Zanzibar before the implementation HMIS**

At the district hospitals and PHCCs, health workers collected daily inpatient and outpatient data with no system of reporting and therefore data was stored in the respective registers within the respective ward or clinic. Therefore, in case some data or report were needed, the incharge of the statistics department or any other health worker had to go to the specific ward or clinic, go through the register books and prepare the required data or report. Table 1 provides a summary of key issues on the HMIS in Zanzibar before the design and implementation process.
In November 2004, the MoH and its stakeholders conducted a HMIS review which revealed the fragmentation of data collection and reporting systems as well as lack of health care data to support decision making. As a result of these findings the decision was to improve the HMIS within the individual hospitals (referral hospital, district hospitals and PHCCs). The Health Information Systems Programme (HISP) project was then contracted in December 2004 to work as the developer in collaboration with the MoH and all its stakeholders. The project timeline was two years (2005-2007).

### 3.2 The HISP Philosophy and Background: Overview

With its origin in South Africa, HISP is currently a large-scale open source software research and development programme. It aims at strengthening and further developing health information
systems (HIS) in public health in an expanding network of developing countries including Tanzania – Mainland and Zanzibar, Mozambique, Malawi, South Africa, India, Ethiopia, Vietnam, Botswana and Nigeria. HISP is mainly coordinated by the University of Oslo, Norway in collaboration with local authorities such as local Universities and Ministries of Health in each country where the project operates. Along with addressing the problems of fragmentation and multiple data standards, HISP has developed a District Health Information Software (DHIS) to support the management and use of health care data. DHIS is open source database application and it can be customized according to a specific setting’s requirements. Currently, the international HISP group undertakes continuous developments of the DHIS. (For more details about HISP and the DHIS see for example, Braa & Hedberg, 2002; www.hisp.info; Braa et al., 2004; Braa & Muquinge, 2007).

The development of the DHIS has followed two trajectories (Braa & Muquinge, 2007). The first starts from 1997 to current, whereby a Microsoft Office DHIS application has been developed in South Africa. The second starts from 2003 to current, whereby a web enabled DHIS has been developed at the University of Oslo using Java tools basing on the functional specification of Microsoft Office DHIS application as a point of departure. While the Java version could complement the Microsoft Office version by allowing modular and distributed development, to most African countries the problems related to the Java version has been that its technologies are complicated and difficult to learn and apply. In this regard, most of the African countries in the HISP network use the Microsoft Office version. This is also attributed by the fact that Microsoft Office applications have been and are in a widespread use among African computer users.

DHIS has a number of features that proves the benefits to examine its design and implementation process from an agency perspective. Most importantly, while the DHIS was initially developed to support district-based primary health care data management, being open source software, it can be configured for both hospital and primary health care data management. The configuration process involves choosing from a range of inbuilt options and parameters to changing the software code so that the DHIS can operate according to specific information requirements. The DHIS allows sharing and transmission of data within and between health care levels through floppies, CDs, flash disks or e-mail. The DHIS’ inbuilt functionalities are likely to affect existing work practices. While there are possible inbuilt options available during the configuration of the DHIS, health care organizations still have a range of options in how they configure and implement this system. These are likely to be affected by social context and require an understanding of individual agency mediated by the
social relations and systems of meaning within which the design and implementation takes place (Grant et al., 2006).

The work of the HISP project in collaboration with health care stakeholders in Zanzibar was to consolidate, reorganize and redesign the data collection tools into a standardized and integrated data management and reporting system. This involved the following activities: (1) identifying and establishing standard datasets for health care data collection and reporting, (2) developing paper forms for data collection, (3) adaptation and use of the District Health Information Software (DHIS) for health care data management, and (4) extensive human resource capacity development on the use of information and communication technologies (ICTs) and health care information. Figure 3 presents the HISP’s model of an integrated HMIS for hospitals in Zanzibar.

As indicated in Figure 3 health workers in the wards and clinics collect data routinely in the register books. At the end of each month the collected data in the register books is summarized in a paper form and reported to the statistics department. At the Statistics department data from the paper forms is entered in the DHIS where analysis and, monthly, quarterly and yearly aggregates can be done. The data from the DHIS is sent to the Ministry of Health and respective vertical programmes through email.

### 3.3 Research Methods

#### Data Collection

This research was carried out within four hospitals in Zanzibar. The research approach was qualitative inspired by ethnographic data collection methods. Miles and Huberman (1994) consider qualitative data suitable for understanding how and why things happen as they do – and even assess causality as it actually plays out in a particular setting. A major reason for the
choice of hospitals in Zanzibar as the study context was the HMIS design and implementation processes in which the first author is participating as a member of the HISP team. In this regard, she played the role of an action researcher and a participant observer in the design and implementation of the HMIS for Zanzibar.

The field research took place during a period of about one year, from January 2006 up to January 2007. The study involved both the historical practices with regard to health care data collection, use and reporting (before the implementation of a new HMIS - period of 2001 to 2005) and the participants’ enactments during the real time HMIS design and implementation process. The concerns about historical practices based on the need to investigate how users’ past experiences with data collection and reporting tools shaped the design and implementation of the new tools.

In addition to the first author’s day-to-day involvement in the design and implementation activities, the principal methods were in-depth semi-structured interviews, participant observation and documents analysis from various sources within the hospitals and the health care sector in general. Semi-structured interviews were conducted with health workers: nurses, doctors, heads of the statistics departments and hospital managers. Interviews were necessary in order to understand participants’ views and basis for their actions (Kvale, 2006) with regard to the HMIS design and implementation activities. Almost half of the informants were interviewed more than once over the field study in order to monitor the changes in enactments as well as getting in-depth understanding of previous responses. Sixty formal interviews were conducted with 41 health workers. The selection of people to interview based on the role of the particular health worker with regard to HMIS activities: data collection, analysis and reporting.

The interview guide contained a set of open-ended questions to facilitate the discussion of relevant issues that facilitated the HMIS design and implementation process. Included were questions about the informants’ past work practices (including the technologies and tools used), prospects for the new HMIS work practices and the choices they made regarding the functioning of the new HMIS (see Table 2). Although the interviews were conducted using an interview guide, informants were allowed to expand and illustrate their responses, while the researcher used probes to follow up on the questions asked (Kvale, 1996). Questions were not asked in the order they were given in interview guide, instead the sequence of questioning based on the informants’ responses. This procedure was followed to avoid imposing the logic of a priori framework on the informants. Additionally, informal discussions were held with the informants and other health workers during the HMIS design and implementation process.
Table 2: Interview protocol and sample questions for data collection

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<th>Category</th>
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| Past work practices                   | Focused on health workers’ experiences with regard to the health management information system (HMIS) activities, routines and work context including technologies used. Examples of questions asked include:  
  - What tools are used for data collection, report preparation and reporting?  
  - What are the formal and informal procedures that facilitate the way in which the HMIS activities proceed? |
| Prospects for the new HMIS practices  | Focused on health workers’ expectations and fears on what and how the new HMIS including the new technologies (new paper forms and the DHIS) can facilitate health care data collection, sharing and use among health care stakeholders. Examples of questions asked include:  
  - What are your expectations towards using the DHIS?  
  - Are there any practices that you do not envision to change? Why? |
| Choices made regarding the functioning of the new HMIS | Focused on health workers’ adjustments that respond to the emerging demands and dilemmas as a result of the new HMIS practices and technologies. Example of questions asked include:  
  - How do the new paper forms enable or constrain your current HMIS activities?  
  - What enhancements should be done with regard to HMIS practices so as to make you more effective? |

Being a member of the HISP team allowed the researcher to conduct a wide range of participant observation sessions. While some of the observations were conducted during the interview sessions, some took place as part of the researcher’s participation in the HMIS design and implementation meetings, workshops and user training activities. Responses from the interviews, informal discussions and participant observation were noted down in summary form using a notebook and pen during the respective sessions. The summary notes were then expanded later on the same day while typing on a computer word processing file. Documentary sources included the existed data collection and reporting tools, HMIS design and implementation plans and progress reports, minutes of the meetings and workshops and health care sector strategic plans. Patients’ records were also analyzed in order to gain understandings of varying health data recording tools and content of data collected and reports produced.

Data Analysis

The data analysis took place as an iterative process throughout the data collection process. Findings across different interview responses, observations, documents and informal discussions were compared through triangulation (Patton, 2002). For example, in order to validate the historical practices described during the interviews, informants responses on historical periods was cross-checked where possible against data collection tools and annual reports written at that early time. The analysis process involved reading and rereading the fieldnotes from which data were coded. Miles & Huberman (1994) assert that, codes for data analysis can be generated from a list of research questions, hypothesis, problem areas and or
other key variables that the researcher brings to the study. The generated codes in this study based on themes from Emirbayer & Mische (1998)’s temporal theory of agency: past practices and experiences, future expectations and imagination of other possibilities, practical contingencies of the present and the context of action. However, given the theory’s lack of emphasis on technology (Chu & Robey, 2008) and the aim and nature of our study, we also generated a code on technology. We used a word processing package to gather data together into a holistic, narrative sequence (Miles & Huberman, 1994).

4. RESULTS

Based on the implementation approach and the empirical material, two important phases occurred during the HMIS design and implementation process. The first phase covered the referral hospital in which the technology (paper forms and the DHIS) had not yet taken form and produced intense discussions and debates around how the HMIS should function. The second phase covered the district hospitals. During this time, the technology and the processes followed at the referral hospital formed the basis for the design and implementation process in the district hospitals. However, due to specific contextual requirements several aspects of the technology had to be modified to fit with the requirements at these hospitals.

4.1 First Phase: Referral Hospital

The HMIS design and implementation process at the referral hospital started by identifying a group of health workers to work with the HISP (designers’) team. The health workers’ group consisted of those working at the statistics department and in-charges (doctors and nurses) from different wards (17 in total) and clinics (18 in totals). In this regard, two visions facilitated the structuring of the paper forms’ and the DHIS’ functionality and appearance: one from the HISP team and the other from the health workers’ group. The HISP team focused on the need for collecting minimum but essential datasets. In this regard, both the paper forms and the DHIS should be simple to use at the same time fulfill the needs for data. The health workers focused on the paper form’s ability to record as many diagnoses as possible. In addition, both the HISP and the health workers had a vision of developing an integrated and centralized HMIS that through the DHIS creates a data repository at the statistics department and give access of data to various health care stakeholders. This vision is reflected in the following statements from doctors and nurses who commented upon the multiple demands for report preparation and reporting.

*There is a tendency for different people within and outside this hospital to ask for the same information from us. But since all have their specific structure and format of the report, we usually have to prepare reports on similar issues several times... We hope that with this database [DHIS] all people who need information will get it at the statistics department (Health worker 1).*
We were reporting to the statistics department on a monthly basis but at the end of the year, the management asks us for an annual report on the activities that have been going on... where was the data we reported at the statistics department? ... With the database [DHIS] we believe this [multiple reporting] will not happen again (Health worker 2).

In this regard, during this phase, the discussions and debates centered on what and how many data elements should be included in the data collection forms, which in turn would be in the DHIS. To address the needs of data from all health care stakeholders, the existed paper forms from the MoH and various vertical programmes formed the basis for the discussion. Examples of the discussion between the HISP team and health workers during one of their initial meeting reflected this debate:

We need to identify the top ten diseases as indicated in the existing data collection forms... those diagnoses that frequently appear throughout the year. These are the diagnoses we will include on the paper forms (HISP team member).

Those will be very few especially in some wards with many diagnoses ... at least we can include the top twenty diagnoses (Health worker 1).

It is better if the new paper forms will have a category called 'others' in which we can record the number of all the diagnoses that are not written on the form (Health worker 2)

...or the forms can have extra empty rows at the end in which each individual ward or clinic can write the extra diagnoses not in the form (Health worker 3).

...but if health workers will be writing the extra diagnoses ... we will face the same problem as with the previous systems (HISP team member).

In dealing with issues from the discussion and debate, both the HISP team and health workers decided to start with paper forms which include the top ten diseases with some extra rows at the end in which health workers can write the extra diagnoses. This approach aimed at monitoring the frequency of the extra diagnoses for a period of six months to determine the necessity of including or not to include them in the paper forms and the DHIS respectively. A prototype of the DHIS was then configured to include the top ten diagnoses indicated in each of the paper forms. During the prototyping of the DHIS, a debate emerged with regard to how data is being collected and the need for integrating data from different wards and clinics through the DHIS. An example was from the VIP ward in which the data elements have a long combination of diagnoses such as Malaria + Hypertension + Diabetic. From the health workers’ experience this ward accommodates patients who usually have more than one disease. During the interviews the incharge of this ward described his experience as follows:
Some of these diseases are usually provoked by malaria... for example, when a hypertension or diabetic person gets sick with malaria it is likely that it [malaria] will provoke her/his hypertension or diabetic condition (Health worker 4).

But for the integration purposes through the DHIS this was a complicated situation since the malaria diagnosis from this ward could not be integrated with malaria diagnoses from other wards, which have malaria as a separate diagnosis (not combined with other diagnoses). One of the prerequisite for the DHIS to integrate data from different wards or clinics is that data should belong to the same group. However, a long combination of diagnoses (such as Malaria + Hypertension + Diabetic) can not belong in the same group with a single diagnosis (such as Malaria). Therefore, to make the integration possible, the HISP team and health workers negotiated on which diagnoses to combine and which ones to separate. The following excerpts are examples of the negotiations that took place:

It is better to leave some of these diagnoses combined ... a combination helped to reveal which disease provokes other diseases... so that we could take precautions when a patient was diagnosed with that [the provoking] disease (Health worker 5).

...How are we going to record a patient who is diagnosed with more than one disease while the diagnoses are listed separately in a paper form? ... If we record a patient in each of the diagnosis, the outcome will be more number of admissions [total] than the actual number of patients in the ward (Health worker 6).

... a patient with a combination of diagnoses can be recorded in each of the specific diagnosis but counted only once when recording the total number of admissions (HISP member).

After six months of using the forms it was revealed that wards and clinics have different frequency of diagnoses depending on the gender and age category of the patients attended. For example, the pediatric ward (for children) has many diagnoses than other wards. Likewise, the gynecology clinic (for women) has many diagnoses than other clinics of which are all important to be recorded. As a result, while maintaining standardized structures (see Appendix 1a and 2a respectively), both the paper forms and the DHIS were designed with different number of diagnoses as per specific ward’s or clinic’s frequency of diseases. Furthermore, while the initial approach was to classify diagnoses under age categories of either below 5 years or above 5 years (see Appendix 2a) for all clinics, health workers argued for a confusion that might happen with regard to some specific clinics. The following excerpt from the health workers illustrated the arguments:

The hypertension clinic should have only the age category of 13 years and above. This is because any patient below that age is required to attend the pediatric clinic and not the hypertension clinic ... specifying in this way will help to remind the doctor or nurse not to record those patients who come
to the hypertension clinic by mistake ... instead s/he can refer them to the pediatric clinic (Health worker 7).

In this case, the initial approach based on the vision for standardization of data collection and reporting. The health workers’ arguments on the other hand, based on their work practices and the hospital structure. To facilitate the data recording activities the negotiations resulted in some of the clinics acquiring different age categories based on proposed innovations. However, to facilitate integration through the DHIS, all clinics had to collect some data categories that were similar (see Appendix 2a).

In their work practices and routines, clinics are sections within the hospital which provide outpatient services. In this regard, all clinics are not expected to report on the number of deaths that has occurred. However, the incharge from the HIV/AIDS clinic argued for the ‘total number of deaths’ data category to be included specifically for this clinic. During the interviews, the incharge gave the following reason for his argument:

*Nowadays HIV/AIDS patients are not admitted so it is difficult to find data on deaths from the wards. Since they attend at the HIV/AIDS clinic the plan is to make follow-ups on individuals ... in which we can record the deaths (Health worker 8).*

As a result, in addition to the standardized data categories for all clinics, the paper form for the HIV/AIDS clinic contained ‘total number of deaths’ as an additional data category (see Appendix 2b).

Another finding with regard to differences in practices between different ward was revealed by the health workers at the psychiatric ward who were recording patients’ data in two separate register books: one register book for ‘new cases’ (i.e. patients who are admitted for the first time) and another register book was for ‘repeated cases’ (i.e. patients who are admitted for the second or more time). Based on the practices in all the other wards this seemed to be a different way of recording data. Wards are not expected to have ‘repeated cases’ (i.e. admission is admission, whether for the first time or the second time or more). Information on how many times a patient has been admitted is recorded in the individual patient’s admission card or file. Arguing about why this way of recording and reporting is necessary specifically for the psychiatric ward, the health workers working in this ward said:

*In this ward a patient can be discharged today and then admitted after one week within the same month... that is why we need to record repeat cases (Health worker 9).*

*If they record without separating them we will have so many psychiatric cases and it will indicate that we have so many psychiatric cases in the country (Health worker 10).*
Thus, the use of two register books helped health workers to differentiate between a new and a repeated psychiatric case within the same month. Based on this, they proposed for the new paper forms (used for reporting) to have a field for recording repeated cases (see Figure 2 for the different types of data collection tools).

4.2 Second Phase: District Hospitals

As the new paper forms and the DHIS took shape and their advantages became evident at the referral hospital, the design and implementation process was replicated in the district hospitals (three in total). The process began by a meeting between the HISP teams, health workers who are in charge of the wards and clinics and heads of the statistics department within the individual district hospitals. The meeting aimed at planning and discussing how the design and implementation process will take place. The decision was to start with the paper forms and the DHIS module designed at the referral hospital and adapting them to fit the requirements at the district hospitals. In this regard, discussion sessions were conducted focusing on reviewing the paper forms and the DHIS module as revealed in the following excerpts from health workers.

The district hospital is at the lower level and provides less health care services as compared to the referral hospital (Health worker 11).

... not all the district hospitals provide similar health care services...some provide more services than others do (Health worker 12).

... patients whose cases cannot be handled here [at a particular district hospital] are referred to either the referral hospital or another district hospital. The paper forms and the DHIS module for the wards should have one more data category called referred cases (Health worker 13).

Other diagnoses specified do not even have sources of information – no diagnoses done in the district hospitals (Health worker 14).

...other diagnoses are specific in this area and are not written here [in the paper forms as well as in the DHIS] (Health worker 15).

The health workers situated and located the design of paper forms and the DHIS module for the district hospitals. For example, all the diagnoses that were identified at the referral hospital but did not have sources of information (not done at the respective district hospital) were deleted from the paper forms and the DHIS respectively. Instead, other diagnoses done by the individual district hospitals were added.

As presented earlier in section 2, contrary to the referral hospital which had routine fragmented systems for data collection and reporting before the implementation of an integrated HMIS, the district hospitals had no routine system for reporting. The introduction of the new paper forms and the DHIS module was a major motivation for preparing routine reports rather than waiting.
for when the need arises. During the interviews the health workers at the district hospitals explained this motivation as follows:

... now I have to organize my register book in such a way that it can be easy for me to get data to fill in these forms (Health worker 13).

The DHIS offers a more comprehensive system with a combination of different functionalities... that will give us an opportunity to collect data and prepare reports efficiently. Accompanied with the paper forms, the wards and clinics can now report data to us [the statistics department] instead of us looking for data from the register books... and then we can use the DHIS to prepare reports (Health worker 16).

Moreover, the developments within the HMIS in Zanzibar in general, and particularly the implementation of DHIS created the need for other ICTs related infrastructures. For example, the need for a network and internet connection for facilitating communication and electronic transfer of health care data within and between various levels of the health care system. To address this need, all hospitals (referral and district hospitals) were connected with internet facilities such as email and ‘Skype’ through which health workers could communicate with each other. For example health care districts could send reports to the MoH through email attachments and using ‘Skype’ to request for the supply of paper forms and technical support from the MoH among other things. Consequently, health workers had to learn how to use internet facilities and computers in general, facilities that they were not using before the implementation of the DHIS.

5. DISCUSSION: THE ENACTMENT OF AGENCY

Based on the aim of our study, we categorize our discussion into four parts, each part elucidating how and why agency was enacted in particular situations during the HMIS design and implementation process within hospitals in Zanzibar. The first part discusses insights from the study in relation to the three dimensions of agency as described by Emirbayer and Mische (1998). The second part addresses technology and its agency (paper forms and the DHIS in this case). The third part discusses the contextual and structural issues that had impacts on the presented design and implementation process. The fourth part addresses the interplay between Emirbayer and Mische’s three dimensions of agency, technology and context.

5.1 Insights from the Temporal Theory of Agency

Through the lens of Emirbayer and Mische (1998)’s temporal theory of agency we view the HMIS design and implementation process within hospitals in Zanzibar as an act of human agency that is simultaneously influenced by the persistence of past practices and experiences, future expectations and imagination of other possibilities, and practical contingences of the
present. The persistence of past practices refers to the *iterational* dimension in Emirbayer and Mische’s conceptualization of agency. In our study, one aspect of these past practices is revealed in the discussions and debate between the HISP team and health workers on what and how many data elements (diagnoses) to include in the data collection forms, which would in turn be presented in the DHIS.

Our study indicates that health workers were confronted with the new ways of health care data collection, that is, the need for collecting minimum but essential data sets, which they were not doing before. However, they were aware of the patterns and fluctuations of diagnoses that they have been dealing with in their everyday work practices. For example, they used their past experience to argue and propose a category called ‘others’ and ‘extra empty rows’ at the end of each paper form. The result of this proposition was paper forms with variations in the number of diagnoses depending on the reality in particular wards or clinics. This result was in contrast to the initial plan of having the same number of diagnoses in all the paper forms. Likewise, in the discussion about the combination of diagnoses, health workers drew on their past pattern of practices to argue about what diagnoses should remain combined and what can be separated.

The second dimension of agency, *projectivity*, is at work whenever existing techniques and rules are applied in awareness of some future state rather than only out of habit or routine (Emirbayer & Mische, 1998). It is also present when new techniques or practices are introduced in order to facilitate change. In our study, the element of projectivity is illuminated when for example; the incharge of the HIV/AIDS clinic suggests the recording of deaths in this clinic. Despite going beyond the standardized format of data collection, what the incharge suggested is an innovation in HIV/AIDS data collection, which, at the same time, had an impact on the structure of this particular form in the DHIS. Likewise, the introduction of specific age categories for the hypertension clinic, for example, is an act of creativity that has the potential to change and facilitate the way in which data within this clinic are collected and interpreted. Moreover, health workers describe the future benefits of the DHIS as the reduction of multiple reporting due to centralized data reporting and storage. In this regard, the illuminated projectivity goes beyond habits or routines; it builds upon imagination and deliberation. This is inline with Emirbayer and Mische (1998) who argue that, when actors exert projectivity, they move beyond themselves into future and construct changing images of where they think they are going, where they want to go, and how they can get there from where they are at present.

The empirical findings also show how participants exert *practical-evaluations*, the third dimension of agency, in response to the particular situation. Quite fundamentally, the health workers have to make practical and normative judgments in response to the emerging demands, dilemmas, and ambiguities of presently evolving work practices (Emirbayer & Mische,
1998) as a result of the new HMIS. Although the standardization of paper forms required that the forms for all the wards should have a similar structure (see Appendix 1a), health workers at the psychiatric ward did not adopt it without attention to the particular situation at hand where they reflect on the impact of the technology structure (both the paper forms and the DHIS) on the number of psychiatric cases. This reflection on situational awareness and judgment became explicit when the health workers argue on the need to make an exception with regard to the psychiatric ward because if not the outcome will be so many psychiatric cases in the country, which will not be the reality.

While the iterational, projective and practical-evaluative elements of agency are discussed separately with respect to how the HMIS was designed and implemented, it must also be kept in mind that, when looking at a set of practices and activities carried out, the three dimensions can complement and support each other in the analysis of agency. For example, a certain degree of iteration is important to achieve projectivity and practical-evaluative dimensions in an organized and manageable way. As indicated in this study, participants’ actions that reflected the projective aspects of agency were strongly intertwined with the channeling of things they have learned and experienced from the past. For instance, based on the previous practices of admitting HIV/AIDS patients, which enabled the recording of the number of deaths, health workers in the HIV/AIDS clinic suggested recording the number of deaths to be part of the future practices within this clinic.

In our case, there was a certain emphasis on the iterational and projective elements of agency. This may of course be different in other situations, such that, generally speaking, the observable activities of systems design and implementation may as well be “more (or less) engaged with the past, more (or less) directed towards the future, and more (or less) responsive to the present” (Emirbayer & Mische 1998, p. 972). This is to say that there are different forms of engagement of participants regarding the enactment of IT and IS-related work practices. However, if the iterational element dominates, the design and implementation process will mainly reflect an engagement with the past patterns of action and routines that might complicate the development of new practices. This may solely be detrimental to systems innovation and organizational transformation. A dominance of the projective element of agency means that the systems design and implementation process exhibits a strong engagement with the future. In this situation the new practices can be understood mainly as a reflection of the future practices and thus not fulfill the requirements at hand. Lastly, a dominance of the practical-evaluative element means that the systems design and implementation process is more responsive to the present. This may result to a system that is less adaptive with the changing environment, which is not appropriate for organizations requiring system flexibility,
such as health care organizations. The outcome from the study shows that it is important to balance between the continuation of the past practices and the accommodation of present and future demands.

5.2 Technology as an Actor

The focus on technology recognizes the influence of previous and new technologies on individuals’ and groups’ actions as well as on how the HMIS design and implementation process proceeded. These influences are reflected in the number of activities that the DHIS can support and the type and variety of activities supported. The DHIS’ primary advantage was its capability in facilitating the integration of data collection, report preparation and reporting activities that health workers were undertaking. As a technological application founded on flexible design principles, the DHIS facilitates the coupling and uncoupling of various data needs from different health care stakeholders. In this regard, the DHIS arose as a pivotal technology in meeting the needs of several health care stakeholders, and thus, it plays a significant role in changing practices of all these stakeholders as well as the relationship among them.

The empirical findings showed that the DHIS had agency that go beyond integrating the separate existed information systems. Its features such as, the need for naming diagnoses in such a way that they can belong in the same group, demonstrate technological agency that had impact on changing organizational work practices and health workers’ day-to-day activities. The grouping functionality of the DHIS made it necessary for identifying all diagnoses with high frequency and standardizing the naming of all the individual identified diagnosis in each paper form for each specific wards and clinic (see Appendix 1b, 2b and 2c). Standardization was necessary so as to avoid incompatibilities between different spellings of the same diagnosis name and thus incompatibilities in grouping diagnoses through the DHIS. This is a transformation in practices as compared to the previous paper forms which allowed individual health workers to write the diagnoses by hand – causing variations in naming them.

Likewise, while health workers used to combine more than two diagnoses in one group, the design of the DHIS necessitated for the separation of the combined diagnoses and thus changed how health workers used to record data in the respective wards. In addition, the study shows that the new paper forms and the DHIS facilitated changes in practices in the district hospitals where health worker used to collect and store data daily in the hand drawn register books. With the new paper forms and the DHIS health workers had to reorganize these register books so as to make it easy to fill in the paper forms and thus facilitate data entry into the DHIS.

Furthermore, the DHIS, network and internet connectivity reshaped health workers’ understanding of communication and how they communicate with each other as well as across
organizational levels. Also, the fact that most health workers were not used to work with computers due to previous systems, which were mainly paper based, the use of DHIS and internet facilities has opened possibilities and motivation for health workers to learn how to use computers.

Another aspect of the technology is revealed in situations where actors mobilize pre-existing technologies (which were mainly paper forms) during the design and implementation of the new HMIS. For example, the study shows that the initial discussion on data elements for the referral hospital based on the pre-existing paper forms from different health care stakeholders. In this regard, pre-existing technologies saved as sources of ideas and as antitheses that re-emphasized the unique needs of each ward and clinic.

5.3 The Double Constitution of Agency and Organizational Context

The focus on organizational context addresses diversity in practices and various roles that health workers play within their work practices, which are sometimes in conflict, and influence the nature of the agentic action which take place (Emirbayer & Mische, 1998; Cousins, 2004). Our study shows variation in practices and roles in two main aspects: within the health care level (i.e. between wards and clinics in the same hospital) and between health care levels (i.e. between the referral and the district hospitals). In this regard, actors exerted agency by responding to the contradictions and dilemmas imposed by the two aspects of their organizational context.

The results from the study show that, the uniqueness of services given (such as, a combination of diagnosis and recording the number of deaths) in some of the wards and clinics, for example, influenced the development of specific data categories for these wards and clinics. Likewise, the fact that wards are dealing with inpatients only and clinics are dealing with outpatients only led to the need for differentiating data categories as well as the design of the paper forms between the wards and clinics (Appendix 1a and 2a respectively).

Moreover, the review process and outcome of the design in district hospitals show how design is and should be located somewhere (Suchman, 2002). The result of the actions taken based on the health care organizational structure (e.g. the district hospitals providing less health care services compared to the referral hospitals), indicating the influence of organizational structure on the way agency is enacted. In this regard, both the HISP team and the health workers had to work diligently both to resist and to accommodate these structures.

In analyzing the role of context on how agency is enacted our study supports the premise of the temporal theory of agency. With a focus on systems development processes, our study however, extends the temporal theory of agency by showing that contextual aspects of the organization
govern not only the ways in which these processes proceed, but also the choice of the content of the system(s) being designed.

5.4 The Interplay of Time, Technology and Context

The research explores the circumstances in which the interplay between the temporal dimensions of agency, technology, and context plays a role in shaping existing work practices. While actors may exert agency that is informed by the past, their agency occurs both through the material constraints and experiences from technologies in design, previous technologies, and context of design. In our study, health workers had previously worked with the fragmented systems of data collection and reporting, which disciplined their performances. Thus, they had to align the material and disciplinary agency of these systems with the projected view of the new HMIS as a single integrative system for all units within the hospital as well between the hospitals, MoH and vertical programmes.

For instance, health worker 1 and 2 described the prospects of the new HMIS as they anticipated that through the DHIS it would reduce the number of similar reports that they have to prepare for different health care stakeholders. However, during their initial discussions with the HISP team they also anticipated that the focus on minimum data sets in the new HMIS will result into the omission of some of the important diagnoses in some of the wards and clinics. In this regard, the health workers’ anticipation based on DHIS as a tool that could facilitate centralization of data collection, their experiences as well as the contextual and structural aspects of their work practices. The health workers’ initial anticipation emphasized the projective aspects of agency, but their later actions were strongly intertwined with the channeling of technological and contextual aspects of their work practices.

Our analysis has similarities with studies using structuration theory, in that it recognizes the duality of agency and structure, where structure is drawn upon in human interactions, but in doing so social structures are produced and reproduced. However, more to our analysis is the fact that the temporal agency view allowed us to examine diverse individual experiences and novel instances of action, which may not have structural properties (Cousins, 2004). For example, the work experience described by health worker 4 and 5 demonstrate a particular instance of agency which is not necessarily drawn upon structural aspects of their work practices.

As technology dimension is not addressed by the temporal theory of agency (Emirbayer & Mische, 1998), the current research extends its explanatory mechanisms in studying changes in practices. The analysis shares similarities with studies of sociomaterial relations (Haraway 1997; Suchman 2007) and that it gives room for the agency of technology (Pickering, 1995;
Haraway, 1997; Latour, 2005). However, the additional innovative feature of our analysis is the fact that it explores the possibility that some nonhumans maybe capable of agency not only due to their relationship with humans but also due to their own intrinsic complexity (Fleischmann, 2006). For example, the DHIS agency is more due to the fact that it is a relational database application built on Microsoft Access. In this regard, its design features reflects the technical considerations of Microsoft Access as a database management system.

6. CONCLUSION AND IMPLICATIONS

This paper contributes to the theoretical and empirical understanding of how agency is enacted in systems design and implementation processes. We have analyzed the design and implementation of the hospital management information systems (HMIS) through the three elements of agency (Emirbayer & Mische, 1998), the role of technology and organizational context. Specifically, we have explored how agents shape and are shaped by the design and implementation of an IT based IS as well as why they act as they do.

Considering that HMIS and health care organizations are particularly challenging because of the heterogeneous number of stakeholders and the required changes on how health care work practices are carried out, our results strengthen and extend the existing arguments to pay particular attention to the temporal nature of agency in technology design and implementation. The results and analysis from this study can be generalizable in social settings sharing similar characteristics, particularly in health care organizations. In these organizations, the interactions between the heterogeneous number of human, technological and contextual aspects of agency makes the outcome of the design and implementation process unpredictable. Thus, a continuous agentic reflection on these interactions is required in order to increase the enabling and decrease the constraining effects.

Our study extends the temporal theory of agency (Emirbayer & Mische, 1998) by including consideration of technology. This allowed an exploration of the interplay of time, technology and context in a single effort, unlike most other theories which allow partial investigation. Moreover, the study contributes to the empirical application of the temporal theory of agency.
References


Appendix 1a: The general structure of paper forms for the wards

### HOSPITAL – WARD MONTHLY REPORT

<table>
<thead>
<tr>
<th>Ward name</th>
<th>In charge's name</th>
<th>Month</th>
<th>Reporting date</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>M</th>
<th>Comments/Maelezo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions/Waliolazwa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharges/Waliotolewa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths/Waliokuwa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laying days/Siku walizolala</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Standardized structure for all wards

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Admission/ Waliolazwa</th>
<th>Discharges/ Waliotolewa</th>
<th>Deaths/ Waliokuwa</th>
<th>Laying days/ Siku walizolala</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
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<tr>
<td>7.</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix 1b: The structure of paper forms for the PSYCHIATRIC ward

### HOSPITAL – WARD MONTHLY REPORT

<table>
<thead>
<tr>
<th>Ward name</th>
<th>In charge's name</th>
<th>Month</th>
<th>Reporting date</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>M</th>
<th>Comments/Maelezo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admissions/Waliolazwa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharges/Waliotolewa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths/Waliokuwa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laying days/Siku walizolala</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Additional field as compared to the standardized structure

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Admission/ Waliolazwa</th>
<th>Discharges/ Waliotolewa</th>
<th>Deaths/ Waliokuwa</th>
<th>Laying days/ Siku walizolala</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Epilepsy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Psychosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Schizophrenia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Neurosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Depression</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Hypomania</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Brain Damage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Confusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Manic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Substance Abuse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Enuresis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Unclassified</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 2a: The general structure of paper forms for the clinics

### Hospital - Clinic Monthly Report

<table>
<thead>
<tr>
<th>Clinic name</th>
<th>In charge's name</th>
<th>Month</th>
<th>Reporting date</th>
</tr>
</thead>
</table>

### Total head counts

<table>
<thead>
<tr>
<th>Total Female head count / Jumla ya wanawake</th>
<th>Total Male head count / Jumla ya Wanaume</th>
<th>Total Repeated clients</th>
</tr>
</thead>
</table>

### Comments/Maelezo

### Total under 5 yrs / Jumla chini ya miaka mitano

### Total above 5 yrs / Jumla miaka mitano na zaidi

### Diagnosis

<table>
<thead>
<tr>
<th>New clients</th>
<th>Repeated clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 yrs</td>
<td>5 yrs +</td>
</tr>
<tr>
<td>&lt; 5 yrs</td>
<td>5 yrs +</td>
</tr>
</tbody>
</table>

### Appendix 2b: Paper form for the HIV clinic

### Hospital - Clinic Monthly Report

<table>
<thead>
<tr>
<th>Clinic name</th>
<th>HIV CLINIC</th>
<th>In charge's name</th>
<th>Month</th>
<th>Reporting date</th>
</tr>
</thead>
</table>

### Total head counts

<table>
<thead>
<tr>
<th>Total Female head count / Jumla ya wanawake</th>
<th>Total Male head count / Jumla ya Wanaume</th>
<th>Total Repeated clients</th>
</tr>
</thead>
</table>

### Comments/Maelezo

### Total under 5 yrs / Jumla chini ya miaka mitano

### Total above 5 yrs / Jumla miaka mitano na zaidi

### Diagnosis

<table>
<thead>
<tr>
<th>New clients</th>
<th>Repeated clients</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 5 yrs</td>
<td>5 yrs +</td>
</tr>
<tr>
<td>&lt; 5 yrs</td>
<td>5 yrs +</td>
</tr>
</tbody>
</table>

### Standardized diagnoses names for all HIV clinics

1. Anaemia
2. Cryptococcal Meningitis
3. Diarrhea diseases
4. Herpes Zoster
5. Kaposis Sarcoma
6. Diaphageal Candidiasis
7. Oral Candidiasis
8. S. Mucopoly
9. Pneumonia
10. PTB
11. Skin manifestation

### Standardized structure for all clinics
**Appendix 2c: Paper form for the HYPERTENSION clinic**

**HOSPITAL – CLINIC MONTHLY REPORT**

<table>
<thead>
<tr>
<th>Clinic name</th>
<th>HYPERTENSION CLINIC</th>
<th>Month</th>
<th>Reporting date</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Total head counts/ Jumla ya wagonjwa</th>
<th>Comments/ Maelazo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Female head count / Jumla ya wanawake</td>
<td></td>
</tr>
<tr>
<td>Total Male head count / Jumla ya Wanaume</td>
<td></td>
</tr>
<tr>
<td>Total Repeated clients</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>New clients</th>
<th>Repeated clients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13 yrs +</td>
<td>15 yrs +</td>
</tr>
<tr>
<td>1. CCF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Hypertension</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Low Blood Pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specific age categories as compared to the standardized structure.

Standardized diagnoses names for all Hypertension clinics.