

The challenges of sustainability of health information systems in developing countries: comparative case studies of Mozambique and Tanzania

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Abstract

The introduction of Information Technology (IT) typically comes with the promise of helping to manage scarce resources, increase efficiencies, reduce workload, and increase work productivity. In the context of developing countries, the lure of these promises is magnified given the existing conditions and inefficiencies. International donors for example the World Bank, or the World Health Organization play an important role in shaping this promise because developing countries are dependent on them for both technical and financial aspects.

Given that IT projects may take a long time to be fully institutionalized, sufficient resources are required to build the local capacity to support and sustain the project after the withdrawal of donors. Inadequate donor support often contributes to weakening rather than strengthening human resource capacity and effective system design, since it emphasizes the technology itself in the expense of the needs of the users. These factors contribute to the design and implementation of unsustainable health information systems (HIS) in developing countries.

Through a comparative case analysis of the HIS in Mozambique and Tanzania, we have identified three sets of relationships as crucial in shaping the sustainability of HIS. The relationships between the Ministry of Health (MoH) and the software development agency, between the MoH and the donors, and between the donors and the software development agency. The reasons for the lack of alignment between the relationships, although possibly different in the two cases, are identified and some specific recommendations are made to support their alignment, and with it, we argue, the sustainability of the system.

Keywords: Sustainability, institutionalization, HIS, Mozambique, Tanzania, human resources development, international donors, user organisation, systems design.

Introduction

The introduction of Information Technology (IT) typically comes with the promise of helping to manage scarce resources, increase efficiencies, reduce workload, and increase work productivity. In the context of developing countries, the lure of these promises is magnified given the existing conditions and inefficiencies. International donors for example the World Bank and the World Health Organization play an important role in shaping this promise because developing countries are dependent on them for both technical and financial resources.

health planning, decision making, and resource allocation. In order to achieve these objectives, many attempts by governments and donors have been reported concerning the design, development and implementation of computer based HIS in different developing countries including Mozambique and Tanzania (Rubona, 2001; Lungo, 2003; Mwaluko et al., 1996). However, many of these efforts have been unsustainable due to political, socio-economic, and technological factors (Mursu et al. 2000). Donor policies (such as short term funding, top down approaches and focus on technology) also significantly contribute to the problem of unsustainable HIS (Heeks et al., 1999).

The domain of health care in developing countries is one such example of donor dependence. For example, in Mozambique 80% of the budget for the health sector is based on international aid (Beattie and Kraushaar, 2000). Developing countries are reported to have a large amount of unreliable health data, poor human resources, and poor IT infrastructure (Sahay 2001; Walsham et al., 1988). Effective Health Information Systems (HIS) are therefore needed to improve the processes of data handling in order to extract useful information for

Historically, the introduction of IT in developing countries through donors' initiatives follows a top-down approach where people at the bottom levels are systematically excluded in negotiation and decision making processes (Walsham, 1992). This approach creates an environment whereby the ownership and control of the project rests with the top level managers and donors, leading to a situation where the users rarely gain control

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¹ The Bruntland Report, *Our Common Future*, is the report made by the World Commission on Environment and Development in 1987. It is often called the Bruntland report after the chairperson of the commission, then Prime Minister of Norway, Gro Harlem Bruntland.

over the technology they ultimately are expected to use. Moreover, donor support for health projects is relatively short term in nature. Given that HIS projects may take a long time to be fully institutionalized, sufficient resources are required to build local capacity (technical, managerial and financial) to support and sustain such projects after the withdrawal of donors. This inadequate support contributes to a lack of human resource capacity, ineffective system design, and a dominant focus on technology rather than on the needs of the users. This contributes to the design and implementation of unsustainable HIS.

Sustainability of HIS is not possible without adequate resources being allocated according to the needs of users and the organization over a reasonable period of time so as to build institutional capacity and decrease the dependence on donors. However, we argue that collaboration between the local organization and donors plays an important role to sustain the changes achieved in the long run. Thus, the focus of this paper is on how such networks can be created to ensure long term sustainability of HIS. More specifically the paper focuses on two research questions.

What factors contribute to unsustainable HIS in developing countries? And what can be done to make HIS more sustainable? These questions are analyzed based on a comparative case analysis for Mozambique and Tanzania.

The paper explores challenges involved in developing sustainable IT based HIS in the context of developing countries where most such systems are developed with initiatives of donors. The paper also draws some recommendations on how to deal with the challenges. Through a comparative case analysis of the HIS in Mozambique and Tanzania, we have identified three sets of relationships as crucial in shaping the sustainability of HIS. The paper aims to contribute to the IS community literature and to guide IS Project managers and donors in understanding the challenges behind the practical development and implementation of sustainable HIS.

The rest of the paper is organized as follows. In the second and next section, we describe the key theoretical concepts informing the paper. The subsequent section, presents the methodology adopted for the study and the data collection. In the fourth and fifth sections the case studies carried out in Tanzania and Mozambique are described. Following that, we provide the analysis, discussion and recommendations in the analysis and discussion section. Finally, some concluding remarks are presented in the eighth section.

Theoretical Background

The problem of unsustainability plagues IS projects in developing countries including HIS. Sustainability refers to the tendency of the system to endure over time and space and is directly concerned with the system to become institutionalized in the workings of the health department. Institutionalization can thus be described as the process by which HIS can be sustained over time.

Sustainability

The term sustainability was emphasized within the environmental domain in the Rio conference in 1992, where the concept of 'sustainable development' was placed on the international agenda. The meaning of sustainability within the environmental perspective described in the Bruntland report (1987)¹ was defined as follows:

Meeting the needs of the present generation without compromising the ability of future generations to meet their needs.

Sustainability implies maintaining something that already exists over time and is often equated with being 'self-sustaining' or 'self-sufficient', implying that no outside support is needed to continue its existence (Reynolds and Stinson 1993). With regard to IT, 'sustainability' implies the ability to identify and manage risks threatening the long-term viability of IT (Korpela et al. 1998). Misund and Høiberg (2003) define sustainable IT as "technology that is capable of being maintained over a long span of time independent of shifts in both hardware and software".

Donors are a key vehicle through which ITs are introduced in developing countries (Wood-Harper and Bell, 1990), creating a dependency of governments on them, for technical and managerial expertise. Because the context is characterized by poor infrastructure, lack of skilled and experienced human resources and, a weak information and computer use culture (Walsham et al. 1988) donor support is required but paradoxically also creates a situation of unsustainability. The risk of failure of donor supported IS projects is very high making sustainability a challenging task (Mursu et al. 2000).

Sustainability can be seen as a process, starting from the inception of the system, to the various processes around design, development, support and implementation. Sustainability concerns the longevity of these processes and how they co-exist over time, especially once external support is withdrawn (Braa et al. 2003). The challenge concerns how the system continues or does not continue to live on within an organization. Some characteristics of a sustainable IT are summarized in **table 1**.

Managing sustainability

An analysis of sustainability concerns identifying the key factors that are likely to affect (negatively or positively) the likelihood of achieving sustainable benefits. Young & Hampshire (2000) argue that sustainability is related to risks as they may impede achieving sustainable benefits. While sustainability refers to long term outcomes beyond the direct influence of the project, risk analysis typically concerns the threats to the achievement of objectives within the project time frame. A sustainability strategy defines the specific approaches to ensure that the benefits are sustained and specifies how key constraints to sustainability are addressed in the implementation (Young and Hampshire 2000).

A key factor influencing sustainability is donor policies that typically follow a top down approach to the design and implementation of the system

(Walsham, 1992). As a result, the IS does not reflect actual work practices at the lower levels of the organization where the system is to be used. The sustainability of IT is highly dependent on the system being able to provide reliable and useful information, and the capability of users at all levels to effectively use the system. The absence of the participation, capability and motivation of users, coupled with an inflexible system design, makes it difficult for the system to evolve over time and for institutional changes to be incrementally adapted (Bisbal et al., 1999).

Characteristics	Description
Long term	IT must be able to survive over time
Demand	The degree to which IT is needed and output it produces
Simplicity	IT is easy to use with clear functionalities
Quality	IT must be supplied with quality data
Responsiveness	IT satisfies users needs and user participation in the development process
Scalability	IT must be capable of handling and addressing work loads
Adaptability	IT allows for easy adaptation of technological innovations and improvements
Stability	IT should be operated by all key actors in the context
Robustness	IT should be fault tolerant in that it may fail without bringing the system down

Table 1
Characteristics of sustainable IT (adapted from Misund and Høiberg, 2003)

ITs are typically introduced in developing countries through a technical approach to facilitate their rapid installation and utilization (Oyomno, 1996), not very dissimilar to the approach used to transfer manufacturing technologies. However, sustainability issues are not only technical (Bjørn-Andersen et al., 1990) but also concern the ownership and management of human and financial capabilities which rely on people and their needs and actions. These are influenced by the organizational, political as well as technological constraints (Walsham, 1988).

Typically donor funding is short term in nature and involves the use of foreign expatriates who return to their home country as soon as the aid period ends. Given the primarily technical focus adapted, after the withdrawal of the donors, projects are often left in the hands of local organizations without the necessary technical and managerial capabilities to sustain the system over time. (Heeks and Baark, 1998; Braa et al., 2003). Such projects cannot become fully institutionalized as they do not become part of the organizations work routines. Typically, there is no clear and explicit sustainability strategy (Young and Hampshire, 2000) left in place to ensure that the benefits, if any, are sustained and can be further strengthened over time (Heeks and Baark, 1998). Sustainability strategies require planning to transcend the project phase in which the donor is involved, and to examine ways to continue with the system and growth after donor funding is withdrawn.

Oyomno (1996) argues that the sustainability of IT is dependent upon the degree of its demand, appropriateness to the user organization, and the availability of local capacity to sustain benefits achieved over time. The demand is linked to the extent to which that technology is needed within

an organization and the output it produces. Appropriateness refers to the quality of information obtained and the financial and human resources capacity available to incorporate changes and institutionalize the technology. Sustainability then depends on both the technical features of the technology including its operational simplicity, flexibility, maintainability, robustness and also the availability and capability of technical, managerial, institutional, intellectual, socio-political, cultural, and physical infrastructure (Kiggundu, 1989). An absence of a socio-technical focus in favour of a technical approach typically causes IS to be unsustainable in developing countries.

Strong donor dependence makes it difficult for planners in developing countries to cope with rapid changes of IT and the capacity to maintain them. In order to achieve appropriate IT design, collective efforts and resources are needed involving various actors (Korpela et al. 1998) including donors, planners, developers and users.

Institutionalization

Institutionalization can be seen as the process by which Information Systems (IS) can be made sustainable over time (Braa et al., 2003). Avgerou (2000) defines institutionalization as "the process through which a social order or pattern becomes accepted as a social 'fact'" [p.236]. IT becomes accepted through socio-technical processes as a social fact and is maintained because of its legitimacy regardless of the evidence of its technical value. A socio-technical aspect leads to the stability of IT since it is absorbed and integrated within organizational structures and routine activities (Avgerou, 2003).

Through institutionalization, IT processes are carried out and sustained within organizations without dependence upon the initiative of a special group, for example, donors. Institutions are historically produced social systems whose formal structures and processes are sustained by systems of shared meaning (Powell and Dimaggio, 1991). Thus, new processes demand adaptations that modify institutional, group and individual formal structures and behaviour, since the imported IT is subject to local social, cultural, and political processes. Institutionalization is thus about making steady and gradual changes in people's belief, understanding and acceptance of the new technology. The basic approach is to build incrementally upon partial achievements and make them part of the routine organisational activities. However, changes in the way of doing things takes time to be understood, accepted, and routinely applied although they are expected to change the way institutions operate and how decisions are made.

Moreover, the impacts of changes made through institutionalisation take time to be recognized, due to the relatively longer time required for institutional adjustments and adaptations (Avgerou 2003). Therefore, the fact that donor funded IT projects are of short term in nature, and follow a top down approach implies that such systems are neither embedded nor fully institutionalized into the actual work processes of organizations.

Methodology

A longitudinal study of HIS in the Ministries of Health of Mozambique and Tanzania forms the basis for this paper. Tanzania and Mozambique are both developing countries located in the Eastern and Southern Africa, bordering the Indian Ocean. Both depend on the international agencies such as the World Bank, the International Monetary Fund, and bilateral donors for the provision of funds to rehabilitate economic infrastructure, alleviate poverty and support the public health systems. Tanzania has a total area of about 945,087 km² with a population of about 34.4 million (2002 census) whereas Mozambique has a population of 17.3 million (2003 est.) with an area of 801,590 km² (The World FactBook, 2003).

In Mozambique, the study was conducted from 2000 to 2002 and in Tanzania from 2002 to 2003. The study was part of an action research effort (Blum 1955; Susman and Evered 1978; Baskerville and Wood-Harper 1996, 1998) in a global research and development project called the Health Information System Project (HISP)². The HISP project aims to create local capacity for data handling and processing in order to support informed decision processes at the national, intermediate and peripheral levels (Williamson et al. 2001; Braa et al., 2001; Braa et al., 2003).

In Mozambique, the study was based in the Ministry of Health (MoH) and in the Gaza province, one of the HISP research sites. The field work included several visits to and from the MoH headquarter in Maputo to the health districts and provincial health directorate of Gaza. Continued interactions within HISP, helped to gain more understanding about the strategy applied to develop the current HIS, its design assumptions, objectives and issues related to sustainability. In Tanzania a similar study was carried out in the HISP research sites in the Bagamoyo and Kibaha districts, the Coast region and the MoH headquarter in Dar Es Salaam.

The data collection methods applied in both cases included group discussions, analysis of documents, interviews (mostly unstructured), (participant) observations and workshops with health managers and health workers linked to the MoH. A questionnaire was also used to guide the interviews with health workers in order to explore their views about the health system in general and its sustainability. These various techniques helped to discover not only what people said but also what they actually did in practice. The action research approach in both cases involved being engaged in interventions such as conducting training programs, participating in the design of a new HIS through HISP, and making presentations to the ministries of health. Document analysis enabled us to determine information about donor's policies and developer's strategies and their relationships with the MoH. The issues surrounding the design of the HIS approach were also analyzed mainly through document assessments and exploration of the HIS software in both countries.

A comparative case study of the HIS in two developing countries helps to understand issues of sustainability relevant to the individual cases

and, examine patterns of similarity and dissimilarity between them.

The case of Tanzania

Tanzania's health information system structure is divided into four levels, including the national, regional, district and health unit levels. Districts are the main operational unit for implementing Primary Health Care (PHC), and also serve as the hub for the flow of health data from the community to the national level.

Prior to 1989, the existing paper based HIS was evaluated as being fragmented providing limited useful feedback and unreliable data (MoH, 1993). To bring in improvements with the existing HIS, the Health Management Information System (HMIS) as a paper based system was designed as the routine reporting system for data and health indicators covering all public, private and Non Governmental Organisation (NGO) health facilities. The goal of the new HMIS was to address the problems of the previous HIS through integration of the parallel systems, ensuring a regular flow of reliable information within and between different levels (MoH, 1993), and to support the agenda of reform through decentralization.

The development of the HMIS started in 1989 with the first version in English converted into Swahili in April 1991. This process involved top level health management professionals assisted by external consultants with financial support coming from various donors (Rubona 2001; MoH 1993). The idea was that the local government would take full responsibility for financing the HMIS after the completion of the initial implementation phase, estimated to cost 1.7 million USD not including personnel and consultancy expenses (MoH, 1993).

The HMIS manual system was tested for the first time in the Mbeya health district in 1991 for a period of six months and then subsequently modified. After modification, the HMIS was regarded as a practical and useful manual system and spread across the Mbeya region by 1993 and nationwide by 1997 (Rubona, 2001).

Process of development of IT based HIS

Based on the current HIS, the MoH, assisted by an external consultant developed a Dbase IV database system in 1992. In 1997, this database was evaluated and due to its technical, design and operational problems, it was decided that it should be replaced with a different computer system in order to comply with the new demands of MoH.

For materialization of the decision, the MoH contracted the services of a local software vendor, whereby development and implementation costs were covered by donors. In negotiations with top level managers at the MoH, the vendor developed the HMIS software using Microsoft Access 97 and delivered it for immediate rollout in all 20 regions of Tanzania in 2000. The HMIS is now computerized at the national and regional levels, remaining paper-based at the district and health unit levels. Although all districts were provided with computers in 2002, the data handling is still manual at the district level.

² Researchers from Norway, University of Western Cape and Cape Town initiated HISP in 1994. HISP implementation initiatives have been extended to neighbouring countries including Mozambique (1999) and Tanzania (2002). See www.hisp.org

A key problem in the development process was that the donor's funds were not given to the MoH, but instead were directly given to the software vendor (Lungo 2003:118) apparently due to the donor's lack of trust in the MoH. Moreover, in the absence of any formal agreement between the MoH and the vendor on how to verify the completeness of the system before its delivery and its future maintenance, various defects related to functionality, reporting and system operation were subsequently reported (Boehning 2002).

The vendor did not solve even a single bug of all errors/bugs reported in June 2001... because the MoH had no money to fix the bugs (Boehning, 2002; Lungo, 2003:119).

Since solving errors/bugs was not contracted, the MoH needed to secure additional funds for maintenance. In addition, because the software vendor had control of the source code, the MoH could not make changes without support from the vendor. The MoH faced a situation whereby further development of the HMIS depended on the vendor while the financial support process depended on the donors. The relationship between the MoH, vendors, and donors was thus fundamentally misaligned.

Currently, the HMIS software is being used regardless of its limitations. However, the MoH had not been able to pay the vendor to resolve the identified problems and address the changing user requirements. A technical review team recommended to:

Contract out the review of the current HMIS software in the light of alternative packages available, with a view to recommending the best option for the national [health] system (MoH, 2002:16).

This recommendation implies that the collaboration between the vendor and the MoH is not likely to happen in the development of the new software. The recommendation to replace the HMIS comes only two years after the system has been in operation, implying a significant waste of resources.

In addition to the misaligned relationship between the donors, the MoH and the vendor, the issues contributing to the system being unsustainable include the lack of human resource capacity and ineffective system design.

Lack of human resource capacity

The HMIS unit of the MoH was given responsibility for the overall coordination of all activities relating to the HMIS, including the training of health workers, and monitoring and evaluation of the nation-wide implementation. However, the unit historically had a severe shortage of skilled manpower and had no any contingency plan to deal with the additional responsibilities. The HMIS unit has thus never been able to accomplish its increased responsibilities (MoH, 2000). The report stated:

The head of department [at the MoH] responsible for HMIS activities is currently undertaking a second MSc. course overseas. [His] sudden departure... did not allow sufficient

time to prepare [acting staff to take over his responsibilities]. [Among seven staff in the HMIS department] three are undertaking studies. One of the remaining staff has additional responsibilities [which are not part of his terms of reference] (MoH, 2000:7).

While assessing the skills of the staff working at the HMIS unit at the national level, we found that most (if not all) had a background in statistics and epidemiology and had basic computer skills but not to the level required to deal with hardware and software issues of the HMIS. For such knowledge, the MoH had to hire external IT consultancy expertise, which was extremely expensive and short term. Our survey emphasized the need expressed by staff to strengthen IT training, in the absence of which they found it difficult to effectively use the computer.

Ineffective system design

The HMIS is a set of data elements, data collection and compilation tools and procedures to help health workers perform their activities. Thus the design of HMIS implied computerization of all selected data elements reported to the regional and national levels, concerning all health services. After the HMIS was implemented in all 20 regions and at the national level, it was evaluated to have a number of problems (MoH, 2000; Boehning, 2002; MoH, 2002):

In summary, criticisms of the HMIS software are related to lack of flexibility, user-friendliness,

- The HMIS was not completely developed as initially intended.
- Inability to perform some operations, such as adding or editing data elements, implying that the data elements were hard coded.
- Absence of functionality to perform basic operations such as sorting, validating or querying data.
- The HMIS generated a number of random bugs, for example some reports were malfunctioning.

organizational control over the source code and systematic support of users from the developer's side. Due to the MoH's lack of capability to deal with the HMIS software constraints, the reported bugs were being collected and historically archived at the national level without any prompt correction action. In this case additional funding was required to deal with HMIS bugs, whereby the vendor awaited for money from the MoH or donors to fix the system bugs or to improve the design, seeing them as extra requirements.

The subsequent evaluation report in 2002 recommended that the HMIS software be replaced with another system that is more flexible whose operation demonstrates to comply with the needs of the MoH (MoH, 2002:16). However the question still remains on how the users' needs will be addressed.

The case of Mozambique

The MISAU³ is the national authority responsible for the management and administration of health services in Mozambique. There is one level of Primary Health Care (PHC) provision (health unit)

³ MISAU: Ministério de Saúde – Ministry of Health in Mozambique.

and three management levels (district, province and national). The data collection, compilation, validation and reporting are basic activities done at the health unit level with summaries sent to the management levels in an aggregated manner. Health services include curative and preventive activities which are hampered by scarce resources, such as human, drugs, transport and others. This creates the need for improved planning and deployment of scarce resources to the areas where the needs are most pressing. The need for improving the HIS has been promoted within this context.

Since independence in 1975, the MISAU has given high priority to developing a HIS, including several revisions of the SIS⁴ and its computerization in 1992 at the provincial and national levels. SIS by definition represents the main storage of data, required for management purposes. Like the HMIS in Tanzania, SIS was expected to support the process of health reform through decentralization.

The issues that have contributed to the unsustainability of SIS include design and development, human resource development and donors' policies.

The design and development of SIS

SIS is a set of tools, procedures and activities aimed at providing information to decision making (MISAU, 1994), and consists of a number of registry books and paper forms designed to handle various data. The data handling tools are classified according to the unit or level of use. So basically a data collection form at each level has the same structure and data elements, differentiated only by a separate code for health unit, district or province. The lower levels are seldom given any feedback by the provincial and district levels, and therefore the system is essentially a top-down system designed for fulfilling the needs of higher levels.

Mozambique is described to have a relatively good data reporting system from health units to the national level in comparison to some other neighbouring countries (MISAU, 2003) like Tanzania. However, the content and quality of what is reported is inconsistent with what is expected (Braa et al. 2001). In addition, the reports merely summarize activities which cannot be usefully applied for planning purposes or to make vertical or horizontal comparisons.

The SIS software was developed in-house by a foreign expert (who is long gone) with the goal of integrating data from more than ten different health programs such as immunization, mother and child health, drugs and infrastructure. However, in practice the SIS software only managed to integrate data two health programs, Immunization and Mother and Child Health. As a result, the remaining health programs set up individual projects supported by different donors to develop and use their own software and computer technology for handling their data. In the absence of overall coordination and control by the MISAU, the systems developed were not capable of sharing information among themselves or with the SIS.

In 2002, the Minister of Health described this fragmented structure in the following way:

[MISAU] was a 'ministry of projects' rather than a Ministry of Health. This led to confusion. Officials lacked clear direction. They dealt with different donors and owed their loyalty to the donor, competing with each other to keep certain teams of individuals around certain projects, receiving differential and unknown top-ups from different donors (even now). The demands are on the few qualified staff to serve particular donors, to follow their routines, to ensure that the donors' money goes to what the donor requires (Minister of Health Songani, 11 June, 2002 quoted in Batley, 2002).

He went on to say:

Consequently, clients or citizens are themselves unclear about who is responsible for what. Even now in the provinces it is common to hear people say 'this is a Country X project, while this is Country Y's. This is an issue of symbolic importance, undermining the sense of nationhood and weakening the sense that issues are a matter for government. Government is frequently seen as the problem while donors are the solution (Minister of Health Songani, 11 June, 2002 quoted in Batley, 2002).

In order to address this lack of integration, another foreign expert with a background in epidemiology, employed at MISAU, developed an integrating spreadsheet system called SIMP⁵ that was subsequently implemented at all provinces and at the national levels in 2002 (MISAU, 2003). SIMP integrates data from finance, public servants information system (SIP), office of cooperation and international projects (GACOP), infrastructure, epidemiological surveillance data, and also SIS through a series of standardized reports that enable cross correlation of major indicators. Different technical evaluation teams criticize the integration of SIMP and SIS because it does not handle the validation of data generated from SIS. Since SIS is reported to have many bugs, SIMP tends to automate these existing inefficiencies.

Human resource development

MISAU has the responsibility for human capacity building through focused and continuous training. The nationwide implementation of SIS was carried out along with training of the potential users in statistics, use of computers and use of SIS for data entry and generation of reports. Since 1992, when training was carried out along with the implementation of SIS, there has been no further training. As a result, there are inadequate skills and human capacity to support SIS functions. Furthermore, most health workers at health units have only a basic primary or secondary education whereas health workers at the provincial or district levels have a slightly higher education level. For example, we discovered that the head of HIS statistics at the province level was qualified as the standard XII level. In addition, to their involvement in clinical work, health staff are also engaged in SIS administration tasks related to data. In summary, the lack of adequate basic education, poor training and heavy workload contribute to the inadequate human resource capacity to support the computer based HIS at all levels of the health structure.

⁴ Sistema de informação de saúde, Portuguese for Health Information System.

⁵ Sistema Integrado de Monitorização e Planificação, Portuguese for Integrated System of Monitoring and Planning.

Donors and MISAU policies

Different aid agencies have individual projects in different departments and this leads to fragmentation in the absence of overall control and coordination (Chilundo and Aanestad 2003). This situation leads to a duplication of effort where donors may redirect their support to the same health or management problems leaving others unsolved. The problem created by parallel donor supported systems is described by Batley as follows:

The [donors] have operational policies and procedural requirements that guide their engagement with partner countries [like Mozambique]. A major problem is that even where [donors] have similar objectives, their specific requirements can be different. As a result, donors and partner countries alike face administrative complexities that reduce development effectiveness. This is a particularly crucial issue for poorer and smaller partner countries. More importantly, the multitude of complex administrative requirements makes it extremely difficult for partner countries to exercise ownership (Batley, 2002: 1).

Analysis and discussion

In the two cases, different issues were discussed highlighting key factors which contributed to the development of an unsustainable HIS. These issues are now discussed in the framework of three key sets of relationships; relationships between the MoH and the software development agency, between the MoH and the donors, and between the donors and the software development agency. These sets of relationships are analyzed within the context of the two cases of Mozambique and Tanzania.

Relationship between MoH and the software development agency

In Tanzania, the software development was entirely delegated to the vendor's control, thus resulting in a system which did not suit the users' needs. The focus was on creating a ready-to-use software with no long term support plans for the users. The Tanzanian MoH was bypassed in this process, and thus its interests, requirements, knowledge, and experience about the needed system was excluded. For example, the HMIS bugs, including malfunctions, identified at the regional levels by the users, could only be communicated to the MoH. However, the MoH did not have the technical capacity, source code, or financial resources to address those problems. There was thus a fundamental mismatch between the users, their needs, the existing problems and how they could be addressed.

Contrary to the Tanzanian case, MISAU in Mozambique had substantial control, at least in the initial stages, over the development of the system while the developer was still working for the MISAU. However, when his contract expired and he left for his home country, the system became unsustainable, since there were no technically skilled individuals at the MISAU to take over the vacant position. And since the foreign expert did not involve any local people in the development

process, no one had the required knowledge to conduct further development or maintenance of the system. Therefore, the system was not capable of evolving with the changing needs and priorities of the different MISAU departments over time. Also, because of the top down approach to development used by the SIS developer, the users were excluded which has led to continued resistance by the users to use SIS.

In both cases the top-down development approach and a dysfunctional relationship between the MoH and the development agency contributed to the creation of an unsustainable system. The reasons for dysfunctionality were, however, different in the two cases. In Tanzania it was because the donor directly gave funds to the vendor bypassing the MoH. In Mozambique, the responsibility of the vendor expired after the system was developed and he left the country.

Relationship between MoH and donors

In Tanzania donors provided financial assistance for the development and initial implementation phase of HMIS. However this funding was basically short term without any strategy to support the post-implementation phase, such as local capacity development, training, maintenance or system enhancement.

Contrary to the Tanzanian case, MISAU obtained money from several donors for systems development. But since donors had their own funds and agendas and operated independently from each other, this led to the creation of multiple systems to support different departments and programs. This problem was magnified because there was no strategy for coordination of these multiple systems by MISAU. This led to the Minister of Health calling MISAU as 'the Ministry of projects'. Another problem in Mozambique, as in Tanzania, was the short term nature of funding leading to systems remaining unsupported in the post-implementation phase.

Relationship between donors and the software development agency

In Tanzania, the developer, a private software firm, received money for the development of HMIS directly from the donor. This led to the developer working for the donor and thus focused on the donor's interests, rather than meeting the long term needs of the MoH. The relationship between the vendor and the donor jeopardized the relationship with the MoH, leading to a lack of ownership and responsibility of the MoH over the HMIS.

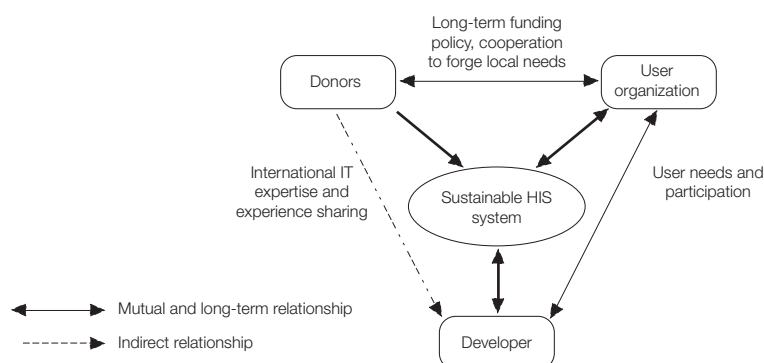
In Mozambique the relationship between the donors and developers was facilitated through MISAU, who had a direct channel of communication with the developers. But the control was of short term nature as the donors funds dried up, and the expatriate left. This left MISAU with no technical or financial capacity to sustain the system (Heeks and Baark, 1998).

Recommendations towards development of a sustainable HIS

Our recommendations are presented with respect to how the three sets of relationships discussed earlier can be strengthened.

Donors have funds and expert knowledge while normally the user organizations in developing countries have a shortage of manpower, skills and are confronted with constantly changing needs. In these terms donors could play a long-term role to assist user organizations to cope with changing demands and needs in an appropriate way. The alignment of resources, interests and responsibilities is crucial to avoid duplication of effort in addressing the health and management problems. For example, in Mozambique there are a number of donor funded projects which contribute to an improper distribution of resources and manpower, and to low performance and outcomes of the overall HIS.

Figure 1
Network of aligned actors towards a sustainable IT



case of Tanzania. The local organization needs to have control over software development process in order to shape it to their particular needs. However, this requires donors' expertise and experience.

Based on the analysis of the two cases and the theoretical framework, we argue that for the sustainability of HIS to be achieved, the interests and resources of all involved actors must be aligned in a common network as summarized in **figure 1**. Actors' interests, knowledge and resources need to be aligned in a network whereby each actor in the network understands its obligations and responsibilities. Such alignment enables the actors to share common understanding about developing sustainable IT systems so that their individual and joint actions become institutionally shaped meeting the goal of the common network. IT development involves a network of actors who are immersed in the institution and not individual actors who exert influence to the institution. Developing a sustainable IT is a process whereby the involved actors succeed by translating their interests into the development and use of IT (Avgerou, 2003).

We further adapt from various authors (for example, Korpela et al. 1998; Misund and Høiberg 2003; Avgerou, 2003; Walsham, 1992) to outline the responsibilities of the individual actors in **table 2**.

In order to ensure that systems accomplish their intended purpose, the developers, MoH and donors need to develop a sustainability analysis and strategy prior to system design and implementation. This is necessary to examine the potential individual impacts of the systems and how each actor's responsibilities can be accomplished. This implies that the system should be developed focusing on users' needs, whose evaluation and feedback should provide the basis for future improvements to the system. The developer needs to study, interact and understand users' needs through involving them in the development process.

During the requirements capturing, design and development of IT, the socio-technical consideration need to be incorporated into the process to create a balanced system that meets organisational needs. The social aspects are composed of the norms, values and assumptions of the organisation, leadership style, formal and informal relationships. Thus the technology needs to be designed to fit the desired organisational social aspects.

We argue that sustainability of an IT system depends on its integration into the organizational complexities and routine work practices through institutionalization. However the institutionalization process takes time and demands a continuous learning curve (Avgerou, 2003) and thus requires a long-term flow of funds. User participation from the inception of ideas of such systems, their initiation, design, development and implementation is also required in order to develop gradual changes in user's understanding and to enable IT to become a normal way of doing things. Such changes need to be carried out incrementally, enabling users to learn from previous changes and to incorporate new changes that emerge over time. Thus, the actors need to create an environment that enables in-house and external generation and sharing

User organisation	
Develop both strategic and operational organisational needs	
Create reliable data sources and infrastructural resources	
Cultivate a habit of information dependence and use	
Plan for institutionalization of IT processes through organizational change	
Build skills and local capacity to adapt to the new organisational changes	
Decentralize the decision making to allow for user participation	
Participate in mobilization of resources for long-term IT support	
Integrate processes and needs to avoid duplication of efforts and resources	
Conduct regular evaluation and assessment of IT	
Donors	Developer
Long-term funding policy	Iterative, incremental and flexible strategy for system development
Long-term strategies to ensure fully institutionalization of processes	
Bottom-up strategy involving top level managers	Design of technology and its institutionalization involving top and bottom level users in the processes.
Local human capacity building through expertise, experience sharing and training	

Table 2
Expected responsibilities of each actor

The actors involved in one way or another with the HIS have roles to play either technically, financially or operationally and their joint actions can be reflected in the sustainable development of an IT system. Moreover, the HIS must be 'needs' and 'local people' driven and appropriate for sustained use (Misund and Høiberg 2003) and its evolution over time. A collaboration between the local organizations and donors plays a key role to sustain the changes achieved in the long run since donors have funds, expertise and experience. Donors should not bypass the local organizations as in the

of knowledge within the sustainability strategy framework.

Planning for institutionalization of new systems such as HIS, creates roles, responsibilities, and budgets to ensure that the HIS becomes part of the existing organizational routines. For example, mandating that all reports should be generated through the HIS, or creating a HIS office, or budget for stationary for printing of the HIS reports, can help to create structures that support institutionalization of the HIS. In summary, processes of sustainability and institutionalization are closely linked. These linkages are examined in the case studies.

Conclusion

This paper started with two research questions: one dealing with what contributes to unsustainability of HIS in developing countries; the second dealing with what can be done about it. The major factor that we found to contribute to development of unsustainable HIS is the misalignment of the interests, roles and responsibilities of the actors involved in the process (the donors, developers and MoH). Effective collaboration between these actors is fundamental to sustain the changes achieved in the long run.

We argue that the interests of the actors should be aligned in a common network to address the long term users' and organizational needs. The user organization, in this case the MoH, in collaboration with donors, needs to build basic, long term, sustainable skills that can survive changing times, technology, and needs. That means development of user skills should be viewed as a continuous process in order to allow use to learn from their experience and to change course when required. Managers need to upgrade their skills for better management of information flows and planning. In order to build and retain human capacity there is a need to build a conducive working environment not only for organizational but also group and individual benefits. A conducive environment implies better workers' benefits, incentives and work procedures created by the involved actors in response to performing their attached responsibilities.

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