JHIDC Health Informatics in Developing Countries

www.jhidc.org
Vol.2 • No.1 • Jan 08

Development of Health Information System in Zanzibar: Practical Implications

Juma Hemed Lungo[a] and Faraja Igira[b]

Abstract

The Ministry of Health in Zanzibar has embarked on Health Information System development with the aim of streamlining health data collection, storage, analysis and reporting in order to attain data-driven informed decision-making. The project involved two aspects: development of essential health data sets and implementation of a computerised data-storage and analysis tool. From January 2005 to December 2007 during the implementation of the project data were collected through a triangulation of qualitative methods: interviews, participant observation, document analysis, software development and training workshops. The study indicates that carefully-planned leadership of a project, clearly-stated goals and distinction between the roles of technical and sponsor networks strengthen an ICT project immeasurably. Lessons drawn include the use of local, culturally-immersed leaders to spearhead the project and the use of flexible open-source software as translators of the primary actor's interest in achieving the goals through enrolling other actors.

Keywords: Open-Source, DHIS, Information Systems, HISP, translation process, network analysis

[a]Department of Computer Science
University of Dar-es-Salaam
P. O. Box 35062
Dar-es-Salaam
Tanzania

jlungo@udsm.ac.tz

[b]Department of Informatics
University of Oslo
Gaustadalléen 23
P.O.Box 1080 Blindern
0316 Oslo
Norway

farajam@ifi.uio.no

Referencing this article

Lungo, J. H., & Igira, F. (2008). Development of health information system in Zanzibar: practical implications [Electronic Version]. Journal of Health Informatics in Developing Countries, 2, 24-32 from http://www.jhidc.org/index.php/jhidc/issue/view/4.

1.0 Introduction

The World Health Organization (WHO) defines the Health Information System (HIS) as a system that integrates data-collection, processing, reporting and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services (WHO, 2004). The collection, collation, compilation, analysis and reporting of health data in the HIS of most developing countries are riddled with major problems. The data received are often not helpful for health management decision-making because they are incomplete, inaccurate, untimely, obsolete and unrelated to priority tasks and the functions of local health personnel (Lungo, 2003). Wilson (2000) suggests that the creative use of information and communication technology (ICT) in health information systems is one of the most promising means of improving the quality, timeliness, clarity, presentation and use of relevant information for primary healthcare.

Despite the tremendous potential that ICT has to support the management of health data, the implementation of ICT in HIS has proved to be challenging (Chandrasekhar & Ghosh 2001; Simba 2004). There are many examples of failed ICT initiatives (Bhatnagar & Bjørn-Andersen, 1990; Heeks, 2002). According to Heeks (2006), there is a huge gulf between the rose-tinted hype about ICT's role in the public sector and the actual reality. The overall result of ICT implementation in the public sector is a massive wastage of financial, human and political resources (Heeks, 2006).

Organisationally, health information systems are heterogeneous, comprised of a number of sub-systems for collecting and reporting data: some of those sub-systems are health facility-based and others are based on vertical programmes such as the Expanded Programme on Immunisation (EPI), TB/Leprosy and Malaria Control Programmes (Chilundo & Aanestad, 2004). These conditions of heterogeneity within the healthcare organisation make the process of developing and implementing ICT-based information systems (IS) a very challenging one (Byrne & Sahay, 2007). Moreover, the lack of resources (both human and material), inadequate skill levels and pressures of everyday work intensify the complexity of implementing ICTs within the healthcare sector, specifically in a developing country context (Chandrasekhar & Ghosh, 2001; Thompson, 2002; Mosse & Sahay, 2003).

An important step in trying to address challenges in implementing ICT within a complex organisational setting is to understand how the interplay between the social and the technical takes place and what can be done in practical terms during design and implementation processes (Stanforth, 2006; Hyppönen, 2007). The paper seeks to contribute to this approach by exploring an interpretative case study of the design and implementation of the Health Information System (HIS) in Zanzibar. The exploration is done through the lens of Actor Network Theory (ANT). The focus is on the complex social processes which are critical for the successful implementation of ICT-based information

systems. Moreover, through Law and Callon (1992)'s network analysis model the interactions between global and local networks of the studied project, and how these interactions have shaped the HIS design and implementation process in Zanzibar, were explored.

The rest of the paper is organised as follows. In section 2, a presentation of the theoretical grounding of the analysis, the translation process and the network analysis model from ANT are provided. Section 3 presents details of the setting and research methods used to collect the empirical material. In section 4, HIS implementation in Zanzibar is outlined. Section 5 presents the analysis of the findings through the translation process and the interactions between the global and local networks. A more detailed discussion of the findings and implications arising from the study is presented in section 6.

2.0 Theoretical Grounding

According to Walsham & Sahay (2006), Actor Network Theory (ANT) has been a popular theory in IS literature in recent years, owing to its explicit way of conceptualising technology as one of the 'actors' in any actor-network analysis. In particular, the moments of translation have been used by IS researchers to study the development and implementation of ICT-based IS (Lee & Oh, 2006; Ramiller, 2005; Stanforth, 2006; Walsham & Sahay, 1999). The use of the moments of translation in these studies has centred on only one form of network found in a project.

Actor Network Theory (ANT) portrays society as a socio-technical web where technical objects participate in building heterogeneous networks that bring together actors (elements) of all types, whether human or non-human (Latour, 1987; 2005). The actor-network is configured and built over time through the enrolment of allies (both human and non-human) by means of the process called *translation* (Callon, 1986). During the translation process, innovators attempt to create a *forum* – a central network in which all the actors agree that the network is worth building and defending.

According to Latour:

> translation occurs as actors enrol allies in the actor network and *align* their interests in a continuous process of renegotiation where claims become well-established facts and prototypes are turned into routinely used pieces of equipment. Since the claim is believed by more than one person, the product bought by more than one customer, the argument incorporated in one more article or textbook, the black box encapsulated in more engines, they spread in time and space (Latour, 1987, p.132).

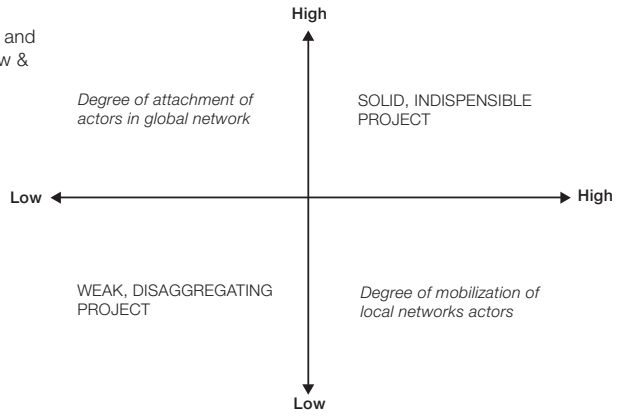
Callon (1986) describes translation as consisting of four moments: problematisation, interessement, enrolment and mobilisation, which are outlined in Table 1. While technological determinism suggests that technologies do evolve under the impetus of technological logic, actor-network theory suggests that technologies do not pass through a neutral social medium (Latour, 1987). Instead, technologies are continuously shaped and reshaped by the interplay of a range of heterogeneous forces within the networks. In ANT terms, design is translation through which users' and others' interests are being reformulated into specific needs, which are further reformulated into more general and unified needs, so that these needs might be met by the same solution (Monteiro, 2002).

Law & Callon (1992) used the notion of translation to analyse the actions of various heterogeneous actors that came together to design the TSR2 military aircraft. Through their study, Law and Callon developed a network analysis framework (Law & Callon, 1992) for analysing two different forms of networks that can be found in a project: *global* network and *local* network. Global network in a project is that set of relations that can be seen as outside the project's local settings and context, built up, deliberately or otherwise and enabling the project to take place with the resources it provides, including money, expertise and political support. The local network is that set of relations that can be seen as the inside of the project and is necessary for the successful production of the working tool (Heeks & Stanforth, 2007; Law & Callon, 1992). The interactions of the actors within the network and between the networks are achieved through items such as project deliverables, physical artefacts and project reports.

Table 1
Central Concepts of the Translation Process

Translation key concepts	Definition
Actor (influential or focal)	Any element which makes other elements dependent upon itself and translate their will into its own language
Problematisation	The first moment of translation during which one or more influential or powerful actor(s) identifies a real-world issue(s) and establishes itself an obligatory passage point (OPP)
Obligatory Passage Point (OPP)	A situation that has to occur for all of the actors to be able to achieve their interests, as defined by the focal actor
Interessement	The second moment of translation, which describes a process of convincing actors experiencing the problem to accept the definition of the focal actor
Enrolment	The third moment of translation, which represents a situation when actors accept interests defined for them by the focal actor
Mobilisation	The fourth moment of translation that occurs as the proposed solution gains wider acceptance and an even larger network is created through some actors acting as spokespersons for others

Figure 1
Mobilisation of Local and Global Networks (Law & Callon, 1992)



Through plotting the changing strength of each network over time, this framework permits a determination of whether a network is progressive or degenerating in terms of achieving the intended goals. In Figure 1, a network's trajectory turns down along the *y-axis* when its global actors begin to lose their attachment and it heads backwards along the *x-axis* when its local actors cannot be properly mobilised. In this regard, a position in the top-right quadrant represents a 'solid, indispensable project,' and a position in the bottom-left quadrant represents a 'week, disaggregating project' (Law & Callon, 1992).

3.0 Research Setting and Methods

The fieldwork took place at the health facilities, district medical offices and the national office of the HIS. A donor agency, two vertical programmes and an academic institution were also studied because of the roles they play in the implementation of the Health Information System Programme (HISP) project. Although the research in Zanzibar took place during the period January 2005 – to December 2007, the authors have been working with the HISP project since 2002 on the Tanzanian mainland and Mozambique. This experience was vital in mapping the peculiarity of development of HIS in Zanzibar.

In seeking to understand the challenges and opportunities in the HIS design and implementation through the HISP, the study was framed as an interpretative approach to case study in information systems research (Myers, 1994; Walsham, 1995; Myers & Avison, 2002). A case study approach examines a phenomenon in its natural setting, using multiple methods of data collection from one or more people, groups or organisations (VanWynsberghe & Khan, 2007). Data were collected through the triangulation of several methods, which included participant observation, in-depth interviews, group discussions, user training workshops and document analysis.

Observations were made during our participation in different HIS design and implementation activities such as software development, during the interviews and during the training workshops. The observations focused on the interactions between different actors and how they align interests, for example, during negotiations on which data elements to include in the data collection forms and on which healthcare indicators the data elements should base on.

In-depth interviews with health workers, vertical programme managers, project managers and consultants were conducted at their workplaces and during consultative workshops and training sessions. A number of the conducted interviews were repeat interviews whereby some informants were interviewed more than once at different times. The interviews did not involve a pre-fixed set of questions, but a set of issues that were identified as important in shaping the design and implementation of the HIS. For example, issues related to what motivated the MoH to initiate the computerisation of the HIS, why the vertical programmes had introduced their individual tools for collecting disease-specific data, etc.

Data collected through participant observation and interviews were supplemented by the analysis of documentary evidence related to the HIS design and implementation process. The analysed documents included health policy guidelines, memorandum of understanding between vertical programmes and the Ministry of Health, project implementation plans and progress reports. Moreover, as members of the HISP project team, the authors participated in discussion groups that took place during project planning meetings, sensitisation workshops, during the design of data collection tools, analysis and reporting tools and DHIS software development testing and user training.

Table 2
List of Informants

Organisation Category	Setting	Informants	Interviews
Health Facilities	Health Centres	14	14
	Hospitals	8	16
District Medical Offices	Unguja	7	17
	Pemba	4	4
Ministry of Health	National HIS Office	4	9
Donor Agency	DANIDA Zanzibar	2	6
Vertical programme	Malaria Programme	3	3
	HIV/AIDS Programme	2	2
	Expanded Programme for Immunisation (EPI)	5	5
Total		49	76

4.0 Case Description

The management and organisation of healthcare delivery in Zanzibar are built on four levels: national office (Ministry of Health), zone office, district medical office and health facilities. In this context, healthcare information flows through the organisational levels vertically from the health facilities to the national office. Health facilities report health data to the district medical offices. At the district medical office, health data from all health facilities within the district are aggregated into one report and sent direct to the national office (i.e. bypassing the zone office). The zone office is not meant for the report of routine health delivery services, but is an important unit for organising delivery of supplies, such as medicine. At the national office, health data from all the districts are aggregated together, analysed and presented according to health priorities.

The Zanzibar Health Sector has a number of sub-systems for collecting and reporting data, some of them are health facility-based and others are programme-based such as the Expanded Programme on Immunisation (EPI), Nutrition Unit, Reproductive and Child Health (RCH), TB and Leprosy, Zanzibar AIDS Control Programme (ZACP) and Malaria Control Programme. All these vertical programmes had introduced their own specific data collection tools. As a result, the Primary Health Care Units and hospitals in Zanzibar had different forms (both handwritten pages and printed forms), for data collection and reporting. In this context, there was a need to develop a unified, effective and action-oriented HIS for Zanzibar. In other countries similar problems of fragmented health information systems (HIS) have been successfully addressed (Braa & Hedberg 2002; Lungo 2003; Braa et al. 2004).

The overall goal of the project was therefore to streamline and integrate the Health Information System (HIS) of Zanzibar as a way of facilitating sharing, generation and use of healthcare information for decision-making. In order to achieve this goal, a number of issues, such as various interests among the vertical programmes and the available tools, had to be aligned. The authors took part in the project as designers and implementers. Taking part in the project gave the authors an opportunity to study the HIS design and implementation trajectory through continuous engagement with actors in both the international and local networks. In the following paragraphs in this section we describe the HIS development trajectory.

In 2004 a team composed of MoH officials and healthcare stakeholders conducted an assessment of the state of the HIS in Zanzibar. The assessment revealed that the system was fragmented and did not support data-driven decision-making. Specifically, there were too many (excessive) data being collected which have no link to indicators and there were overlaps and inconsistencies in data reporting. The results of the assessment were then discussed in November 2004 at a workshop which brought together all stakeholders and a representative from the Health Information System Programme (HISP). HISP is a research and development programme with long-term experience in implementing HIS in a network of developing countries, including the mainland part of Tanzania. In this workshop a strong commitment to developing an effective HIS emerged, and a plan of action ("roadmap") was agreed upon. The developed roadmap envisioned the following activities:

1. Developing essential indicator and data sets and streamlining the data collection tools in respect of data and information needs.
2. Developing and implementing a computer database to assist the process of storage, analysis and sharing of heath data.

During the meeting of November 2004 the District Health Information Software (DHIS) was chosen as a framework for developing working software for the HIS in Zanzibar. DHIS is free and open-source software that was originally developed by the HISP project in South Africa. Being free and open-source software, the DHIS provides the following opportunities: the Ministry can legally customise the software according to local requirements, can install the software on any number of computers and assign any number of users to the software (Perens, 2005; Rosen, 2005).

The HISP was contracted as a technical implementation team to work together with a newly-formed task force of the Ministry of Health in Zanzibar. A local team of programmers was hired by the HISP to customise the DHIS software. As a network, the HISP Zanzibar has invited HISP members from India, Norway and South Africa to provide technical support and know-how to the local team. In this project, the main activities were to set up the DHIS database and customize DHIS data entry forms as well as formulating various reports to be used in the Zanzibar HIS.

In January 2005, HISP Zanzibar and the task force started by analysing the existing health data collection tools. They listed all health data elements[1] and indicators found in those data collection tools, and tried to map the relation between the indicators and health data elements. One rule was that, if a data element was not used to derive any indicator, it should be considered for disposal. This approach helped to drop as many data elements as necessary in order to avoid collection of too many data which could not be used for decision-making.

After completion of the list of data elements, the next step was to build a 'data dictionary' in order to ensure that for each health data element there was one, and only one, definition. The idea was that all health workers must have a single point of reference in interpreting health data elements. In creation of the data dictionary, again some data elements were dropped since they carried different names but had the same semantic meaning.

The other activity that followed was to re-design the data collection tools. This required developing new data collection forms and testing them. The focus here was on the forms being simple to fill in. For example, a single A4 page was preferred to the old forms consisting of 2 to 4 pages. The designed forms were then prototyped in four out of ten districts; two districts in each of the Islands: Unguja

[1] Health data items and encounters being recorded such as diseases' names, total outpatient visits, etc.

and Pemba. In this process, health workers were asked to use real heath data. The main purpose of prototyping was to test the applicability of the new tools in terms of coverage of data elements and user friendliness. Comments from the pilot districts were collected and addressed in a second round of form-design process.

In March 2005 a workshop representing all district medical officers and vertical health programmes was conducted to confirm new essential datasets (a minimum list of health data elements). Later, in December 2005, a meeting led by HISP consultants was conducted following one week of fieldwork in order to: define the essential indicator set basically based on Millennium Development Goals (MDGs) and the Zanzibar Poverty Reduction Plan (ZPRP); and revise the data collection tools based on the defined indicators and the collected comments from the pilot districts.

The meeting paved the way for scaling-up the newly-designed data collection forms to be used in all health facilities in January 2006. Since this countrywide implementation, a number of training and user supports have been provided to health workers.

5.0 Findings and Analysis

5.1 Problematisation

In the problematisation phase, the initiator becomes indispensable by presenting a solution to a problem. In our case this was initially done by the Ministry of Health (MoH) and its stakeholders who did a rapid assessment of the HIS status in 2004. During this initial stage, the HIS was *problematised* as the need for designing and implementing an integrated, effective and action-oriented HIS. During the interviews one of the health managers at the MoH expressed the problematisation moment, *"we needed an integrated system which could unify all the existing vertical programmes and reduce workload of health workers who had to deal with so many forms from each individual health care programme* (MoH Officer, Zanzibar).

The solution to this problem however, demanded many different actors: experts in information systems design and implementation, financial resources, hardware and a number of users to participate in the design process. In view of the required resources, the HISP was seen as a solution to the need for expertise. The Danish International Development Agency (DANIDA) was seen as a solution to the need for financial resources. A group of users were identified, which included health workers from different levels of the healthcare organisation and from various vertical programmes.

5.2 Interessement and re-problematisation

The beginning of the HIS implementation process was marked by initial consultations between the MoH, its stakeholders and the HISP. These consultations were done through several meetings in which the status of the HIS in Zanzibar was discussed.

Parallel to the meetings a joint HISP, supporting healthcare stakeholders (particularly WHO) and the MoH team conducted a one-week study as a way of experiencing what came out of the assessment done by the MoH and its stakeholders and thus proposing a practical solution to the problems. During this study the need for software for healthcare data analysis, among other issues, was raised. One district health manager reiterated, *"We need a computerised system to help us in data analysis. For example, preparing a top ten diseases report…is very difficult – we have to go back to the health facilities looking at their daily collected data …if we (the district) need to know the top ten diseases in our district* (District Medical Officer, District Medical Office).

Getting the HISP interested marks the moment of re-problematisation in which the HISP became a focal actor in the development process. This time a plan for solving the problems was unveiled. The proposed plan suggested that the HIS with a minimum essential indicator and data sets, user capacity development and software for data storage, analysis and sharing between and across healthcare levels would be indispensable. In this regard, the District Health Information Software (DHIS) was seen as an obligatory passage point (OPP) since it could accommodate, unify and support the interests of all stakeholders.

In order to develop an integrated HIS that would include the interests of all the vertical programmes there was a need to persuade the vertical programmes of the validity of the proposed solutions. As a result, a workshop involving all healthcare stakeholders, the MoH, vertical programme managers and the HISP team was conducted. In this workshop, the HIS status and the proposed plan for solving the problems were discussed. The result of the workshop was a joint agreement on the way forward. The proposed plan was turned into a 'roadmap' for the development of an integrated HIS for Zanzibar.

5.3 Enrolment

HISP was the first actor to be enrolled by the MoH through its need and desire for change within the HIS. Through the HISP's development and research network, several actors were enrolled in the HIS design and development actor-network. The enrolled actors through the HISP network include the University of Oslo (UiO), University of Dar-es-Salaam (UDSM), software programmers, researchers and trainers.

In this actor-network staff from UiO were responsible for general coordination of the project. In addition, postgraduate students and professors from the UiO participated in the project as a case study for their respective researches. The UiO had long cooperation with the UDSM; software developers were contracted by the UDSM to customise the software in Zanzibar. Some of the software developers are working at the State University of Zanzibar (SUZA).

The process of enrolling supporting healthcare stakeholders such as WHO and DANIDA was not as challenging as dealing with vertical programmes, which demanded detailed and continuous negotiations. Both WHO and DANIDA were involved

in supporting different healthcare development programmes within the health sector in Zanzibar prior to the problematisation of the HIS.

The task force consisting of health officers working under the MoH, which was created during the workshop on discussing a proposed implementation plan was an initial strategy for getting users involved in the design and implementation process. The general objective of the new HIS was to reduce and simplify the data elements for data collection. While many simplifications suggested by HISP and the MoH to the specific vertical programmes were agreed upon, others were not. Through a relatively intensive democratic process of identifying and revising information needs from individual vertical programmes, a sense of ownership of the process among vertical programmes was created, which was important for further development of the HIS. Each data element suggested by the individual vertical programmes was discussed according to its usefulness for calculating indicators.

Another strategy for getting users enrolled (particularly those who were not in the task force) was the piloting of the new data collection tools (both the paper forms and the DHIS) through which users could experience the benefits and limitations of the new system and give suggestions for further improvements. This was done in parallel with training users on how to use the designed forms and the DHIS. In expressing the benefits of the system after the piloting phase, one health worker at the health facility concluded that, *"The new forms are more user-friendly than the old. The forms are simpler, with fewer elements to fill in."* Similarly, a health worker at the district office said that, *"with the DHIS we can easily make a report on the top ten diseases for the population basing on specific age groups, something which we had difficulty 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* (DHIS User, District Medical Office).

5.4 Mobilisation

Once the needs of the different actors are met, it is possible for some actors to speak on behalf of the focal actor (Latour, 2005). After a countrywide scaling-up of the new paper forms and the DHIS, health workers in different facilities could complain about those vertical programmes which continued to supply separate forms for collecting disease-specific data. An example is a health worker who said that, "we have these other forms which we got from Mr… They are specifically for the Malaria programme, three forms in bunches for the whole year - 1 stroke form, one reporting form and one for laboratory results. This is strange because they were involved in the design and training of the new integrated forms. In fact they are the ones who were given the responsibility of training us on the new forms. Other data elements specified in these forms do not even have sources of information because this hospital does not perform this kind of service (Health Worker, Health facility).

The increasing health workers' awareness of the benefits of having an integrated and action-oriented HIS served to strengthen further the use of the new HIS.

5.5 The Network Analysis

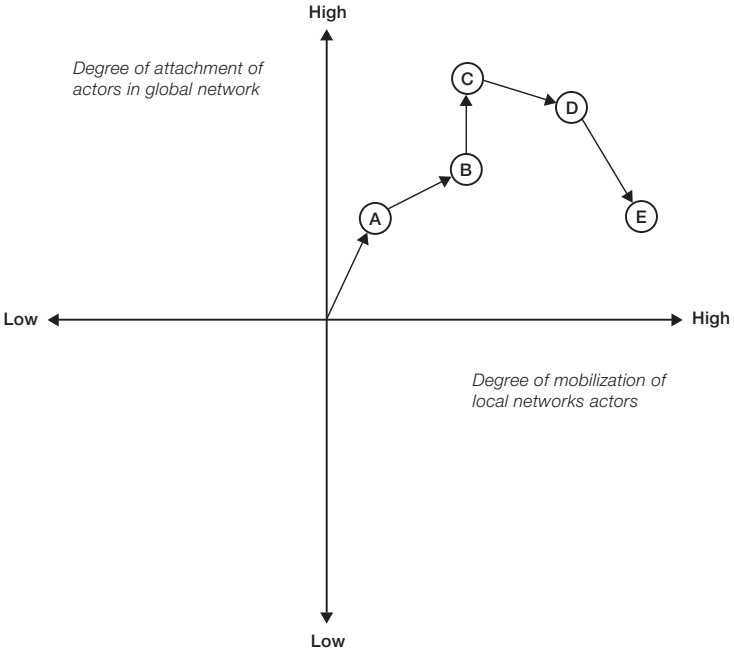
The process of streamlining, integrating and computerising the HIS has involved both global networks and local networks. Hence the trajectory of this project can be better analysed by means of the network analysis model developed by Law & Callon (1992). They assume that the 'degree of mobilization of local network actors' forms the x-axis and the 'degree of attachment of actors in global network' forms the y-axis. At any time a project can be gauged to determine the quadrant where it falls, and so the model can be used to analyse how the implementation of a project is managed so that it reaches its goal(s). The global and local network actors who were enrolled in this project are shown in Table 3.

Table 3
HIS Implementation Project Trajectory as a Function of Networks and Inter-relations

HIS Solution Trajectory	Enrolled Network Actors	Network Inter-relation
Phase 1: Preliminary phase • Design of data collection forms	**Local Network** • Mnistry of Health • HISP **Global Network** • DANIDA • WHO	• Project accepted as OPP • Initiation of intermediaries between global and local networks
Phase 2: Design and Implementation • Design of data collection forms • Testing of data collection forms • Customisation of DHIS Software • Testing of the DHIS software • Revision of data collection , analysis and reporting tools • Countrywide implementation of the forms and the DHIS	**Local Networks** • Vertical programmes • Health workers • UDSM • Local System developers • International HISP Consultants **Global Network** • DANIDA • WHO	• Negotiations on Health Indicators and Data Elements • Training Workshops • Negotiation of the data collection and reporting routines
Phase 3: Consolidation and orientation • Revision of data collection forms and the DHIS • Development of the HIS guideline	**Local Networks** • Health workers • Local System developers • International HISP Consultants **Global Networks** • Vertical programmes • WHO • DANIDA	• Negotiations on the responsibilities of each healthcare stakeholder

The translation trajectory of the project is mapped in Figure 2. The project started in the centre of the diagram when the Ministry of Health (MoH) and its stakeholders agreed on the need for improving the HIS in Zanzibar, which was broadly translated as the need for an integrated HIS that would accommodate the interests of the MoH, all the vertical programmes and other healthcare stakeholders. Thus the HIS implementation process was initiated and the global network was formed (point A): enrolment of the funding agency (in this case DANIDA) and the technical agency (HISP). The enrolled global network made resources and conceptual space available for the HIS implementation to take place. With the MoH as a key actor the degree of mobilisation of the local network was very high.

Figure 2
HISP Zanzibar Network Analysis (based on Law & Callon 1992)



The project was then delineated and the elements of the local network were mobilised (point B) and a task force involving vertical programmes and health workers from various levels was created. In addition, there was further formation of the global network owing to the need for expertise in designing the paper forms, customising the DHIS and training users (point C). That is, the enrolment of UDSM, system developers from SUZA and HISP consultants from other countries.

Further enrolment of actors in the global network resulted in further mobilisation of the local network because through testing and training users on the paper forms and the DHIS more health workers and other stakeholders became involved in the HIS implementation process (point D).

By the time our study was ending the DHIS was installed in all districts in Zanzibar, several health workers were trained in using the system and health data collection tools were being used with continuous revisions. Thus, the project is increasingly relying on local networks with little technical support from the global network but still being funded by the global network (point E).

6.0 Discussion and implications

In this paper both the "moments of translation" and Law & Callon's network analysis model were used to present and analyse the trajectory of HIS implementation in Zanzibar. The project trajectory presented is not only about success and failure but includes all events happening in the project. Thus it was important to use the moments of translation in order to present all activities that happened during the implementation of the project. This covers explanation of the processes of building the network and connections and hence unpacking how an actor had a 'power over' something. Moreover, the network analysis model helps to explain network mobilisation and connections between the local and global networks to illuminate the project trajectory.

With the translation process it was shown that, depending on the defined roles, the enrolled actor can acquire the position of the focal actor, which may lead to the reformulation of the obligatory passage point (OPP). According to the network analysis model used, the trajectory of the project depends very much on available resources provided by the global networks; the strength of the local network to implement the project; and the way the project itself ties the global networks and local networks together. The strength of these three factors keeps a project in the first quadrant of Law and Callon's network analysis model.

The case has shown clearly that information systems implementation involves continuous political negotiations, where actors and their associated power bases can succeed in translating their interests into the development and use of ICT application. Kimaro & Nhampossa (2007) argue that the interests of actors in health information systems implementation that involve donors, developers and Ministry of Health should be aligned in a common network to address the long term users' and organisational needs. In this particular case, the interests of the project initiator, the Ministry of Health, were successfully adopted by others. Heeks & Stanforth (2007) contend that information systems innovation is a contingent outcome that is determined not by the properties of the technology but by the result of contested interests of actors linked together in complex networks. There were several contested interests around health data elements: vertical programmes wanted to collect detailed health data from fewer disease problems in contrast with the Ministry, which focuses on essential and minimum data sets for all disease problems. This resulted in a debate as to which health data elements were to be excluded and on which ground. The debate became intense when the contested data element was of great interest to a particular vertical programme.

In addressing the question of what actions to take to ensure that ICT initiative goals are met, the actor-network theory used in this study divided the project into two networks (local and global) linked by an obligatory point of passage, the District Health Information Software. A detailed account of the organisation of the project in Zanzibar was presented. The implication here is that issues should be addressed as they arise in order for the

point of passage to be built and maintained. Thus, as Ciborra et al. (2000) put it, "project management needs to steer a creative drifting process." That is, building the point of passage needs to be carried out by a member of the client system and committed individuals. A lesson is drawn here in that the Ministry of Health formed a task force of six health workers to spearhead the project.

Both networks had their strengths in this project. While the global network had the power of approving progress reports and design of data collection tools, the local network was responsible for implementing the policy, orders and suggestions. The two networks needed each other in order to realise the goals of the project. Thus, analysing the project in terms of the network analysis model is useful in unpacking the strength of each network. The overall implication here is that the project becomes indispensable when the networks are strong and working towards a common goal. There are three key interrelated factors that Law & Callon, (1992, p.46) propose with regard to the use of the network analysis framework:

- the capacity of the project to build and maintain a global network that will for a time provide resources of various kinds in the expectation of an ultimate return.
- the ability of the project to build a local network using the resources provided by the global network to ultimately offer a material, economic, cultural or symbolic return to actors lodged in the global network.
- the capacity of the project to impose itself as an obligatory passage point between the two networks.

Moreover, Law & Callon (1992) argue that the achievement of the project's goals is determined by the degree and form of mobilisation of the two networks and the way in which they are connected. The more heterogeneous the actors that make up the network are, however, the more problematic the extent to which the project can control its two networks. An example is the struggle to develop essential health data sets in this project.

A practical implication of the study is the emphasis on project leadership. The argument here is that leadership means a combination of many things, including political mobilisation, technical capability and collaboration. A careful selection of committed leaders and identification of 'champions' (people ready for change); changing from a paper-based system to a computerised system in this case, fosters smooth building of the networks.

Oak (2007, p. 2) argues that health informatics in developing countries can be progressed due to "an open, rule-based, predictable, non-discriminatory trading and financial system in developing countries". Our argument is that in software business for health information systems, the Oaks argument can better be realised through the use of Free Open Source Software (FOSS). The characteristics of the DHIS software as an open source gave it strength as the right obligatory passage point actor of all actors in the two extremes, global and local networks. Various stakeholders, such as vertical programmes, international agencies and the Ministry of Health, were glued together by the fact that the resulting software will be a good public product. Thus, the focus is to integrate data collection and storage tools in order to relieve health workers of the burden of chaotic health data collection. Furthermore, the opportunities brought by open source include software localisation, means of acquiring software development knowledge and fostering of political integration. Kimaro (2006) suggests that in order to build sustainable health information systems, human resource development through learning new technologies especially ICT technologies is important. Because free open source software ships with its source codes (Weber, 2003), software developers learn software development styles and techniques through customising software developed by experienced IT professionals.

7.0 References

Bhatnagar, S., and N. Bjørn-Andersen. 1990. *Information Technology in Developing Countries*. Amsterdam: North-Holland.

Braa, J., and C. Hedberg. 2002. The Struggle for District-based Health Information Systems in South Africa. *The Information Society* 18(2): 113-127.

Braa, J., E. Monteiro, E., and S. Sahay. 2004. Networks of Action: Sustainable Health Information Systems Across Developing Countries. *MIS Quarterly* 28(3), 337-362.

Byrne, E., and S. Sahay. 2007. Participatory Design for Social Development: A South African Case Study on Community-Based Health Information Systems. *Information Technology for Development* 13 (1): 71–94.

Callon, M. 1986. Some elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. In *Power, Action and Belief: A New Sociology of Knowledge?* ed. J. Law, pp.196-233. London: Routledge.

Chandrasekhar, C. P., and J. Ghosh. 2001. Information and communication technologies and health in low income countries: the potential and constraints. *Bulletin of the World Health Organization* 79 (9): 850-855.

Chilundo, B., and M. Aanestad. 2004. Negotiating multiple rationalities in the process of integrating the information systems of disease-specific health programmes. *Electronic Journal of Information Systems in Developing Countries* 20 (2): 1-28.

Ciborra, C. U., Braa, K., Cordella, A., Dahlbom, B., Failla, A., Hanseth, O., et al. 2000. *From Control to Drift: The Dynamics of Corporate Information Infrastructure*. Oxford: Oxford University Press.

Heeks, R. 2002. Information Systems and Developing Countries: Failure, Success and Local Improvisations. *The Information Society*, 18(2): 101-112.

Heeks, R. 2006. *Implementing and managing eGovernment: an international text*. London: Sage.

Heeks, R., and C. Stanforth. 2007. Understanding e-Government project trajectories from an actor-network perspective. *European Journal of Information Systems* 16 (2): 165-177.

Hyppönen, H. 2007. eHealth services and technology: Challenges for co-development. *Human Technology* 3 (2): 188–213.

Kimaro, H. 2006. Strategies for Developing Human Resource Capacity to Support Sustainability of ICT Based Health Information Systems: A Case Study from Tanzania. *Electronic Journal for Information Systems in Developing Countries*, 26(2): 1-23.

Kimaro, H., & Nhampossa, J. (2007b). The Challenges of Sustainability of Health Information Systems in Developing Countries: Comparative Case Studies of Mozambique and Tanzania. *Journal of Health Informatics in Developing Countries*, 1(1): 1-10.

Latour, B. 1987. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge: Harvard University Press.

Latour, B. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Law, J., and M. Callon. 1992. The life and death of an aircraft: A network analysis of technical change. In *Shaping Technology/Building Society*, eds. W. Bijker and J. Law, pp. 21-52. Cambridge, MA: The MIT Press

Lee, H., and S. Oh. 2006. A standards war waged by a developing country: Understanding international standard setting from the actor-network perspective. *Journal of Strategic Information Systems* 15: 177-195.

Lungo, J. H. 2003. *Data Flows in Health Information Systems: An Action Research Study of Reporting Routine Health Delivery Services and Implementation of Computer Databases in Health Information Systems*. Oslo: University of Oslo.

Madon, S., S. Sahay, and J. Sahay. 2004. Implementing Property Tax Reforms in Bangalore: An Actor-network Perspective. *Information and Organization* 14 (4): 269–295.

Monteiro, E. 2002. Actor-Network Theory and Information Infrastructure. In *Control to Drift: The Dynamics of Corporate Information Infrastructure*, eds. Ciborra et al. pp. 71-83. Oxford, Oxford University Press.

Mosse, E. L., and S, Sahay. 2003. *Counter Networks, Communication and Health Information Systems: A Case Study from Mozambique*. The IFIP TC8 & TC9/ WG8.2+9.4 Working Conference on Information Systems Perspectives and Challenges in the Context of Globalization, Athens, Greece.

Myers, M. 1994. A Disaster for Everyone to See: An interpretive analysis of a failed IS project. *Accounting, Management and Information Technologies* 4 (4): 185-201.

Myers, M. and D. Avison (eds). 2002. *An introduction to Qualitative Research in Information Systems. Qualitative Research in Information Systems: A Reader*. London: Sage.

Oak, M. R. 2007. A Review on Barriers to Implementing Health Informatics in Developing Countries. *Journal of Health Informatics in Developing Countries*, 1(1): 1 - 4.

Perens, B. 2005. The Open Source Definition. http://perens.com/Articles/OSD.html (accessed December 9, 2007).

Ramiller, N. C. 2005. Applying the Sociology of Translation to a System Project in a Lagging Enterprise. *Journal of Information Technology Theory and Application* 7 (1): 51–76.

Rosen, L. 2005. *Open Source Licensing: Software Freedom and Intellectual Property Law*. Upper Saddle River, N.J.: Prentice Hall.

Simba, D. O. 2004. Application of ICT in Strengthening Health Information Systems in Developing Countries in the Wake of Globalization. *African Health Sciences* 4 (3): 194-198.

Stanforth, C. 2006. Using Actor-Network Theory to analyse E-government Implementation in Developing Countries. *Information Technology and International Development* 3 (3): 35-60.

Thompson, M. P. A. 2002. Cultivating meaning: Interpretive Fine-tuning of a South African Health Information System. *Information and Organization* 12 (3): 183–211.

VanWynsberghe, R. and S. Khan. 2007. Redefining Case Study. *International Journal of Qualitative Methods* 6 (2).

Walsham, G. 1995. Interpretive Case Studies in IS Research: Nature and Method. *European Journal of Information Systems* 4 (2): 74-81.

Walsham, G., and S. Sahay. 1999. GIS for District-Level Administration in India: Problems and Opportunities. *Management Information Systems Quarterly*, 23 (1): 39-66.

Walsham, G. and S. Sahay. 2006. Research on Information Systems in Developing Countries: Current Landscape and Future Prospects. *Information Technology for Development* 12 (1): 7–24.

Weber, S. (2003). *Open Source Software in Developing Economies*. http://programs.ssrc.org/itic/publications/ITST_materials/webernote2.pdf (accessed April 24 2007).

WHO. 2004. *Developing Health Management Information Systems: A Practical Guide for Developing Countries*. Geneva: World Health Organization.

Wilson, R. 2000. Using Computers in Health Information Systems. In *Design and Implementation of Health Information Systems*, eds. T. Lippeveld, R. Sauerborn and C. Bodart, pp. 198-212. Geneva: World Health Organization.