

TRANSLATIONS AS SHAPED BY INSTALLED BASE AND ACTORS' INTERESTS

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Abstract: The knowledge, expectation, assumption, and interests of actors constrain and permit certain sets of communications and functionalities of ISs; specify actors, roles, and expected competencies; and influence the choice of development technologies and specify future trajectories. Besides this knowledge, it is crucial to uncover the process in which ISs acquire these characteristics, and their material and functional forms. This paper shows the processes of embedding actors' interests, the dynamics of role delegation, and its relationships towards achieving the goal of implementing ISs. The paper reveals that roles can be allocated to actors to preserve a network regardless of the effort required to perform it jeopardizing the aspirations of IS implementation; the same task can be delegated to human and non-human actors at the same time in different contexts; and choice of technologies used to develop ISs can be dictated by the dominant actor, may not also consider the context. The paper shows the strategy adopted to establish and perpetuate a socio-technical network in the courses of developing and implementing an IS in the healthcare sector of a developing country context and shows how to overcome the identified challenges.

Keywords: Is design, translation, developing country, actor-network theory, health information system, antiretroviral therapy system, installed base, actors' interests, inscription, program of actions.

TRANSLATIONS AS SHAPED BY INSTALLED BASE AND ACTORS' INTERESTS

INTRODUCTION

The knowledge, expectation and assumptions of individuals about the purpose, context, importance, and role of that technology influence the design and use of technology (Bijker 1995; Hanseth and Monteiro 1997; Markus 1983; Monteiro 2000; Orlikowski 1992; Pinch and Bijker 1984). The material form and function of technologies also embody their sponsors' and developers' objectives, values, interests, and knowledge of that technology (Orlikowski and Gash 1994). The choice made by sponsors' and developers', for example, determines the process of work, the division of labor, autonomy of employees, and the decentralization or centralization of units and decisions. The technology also influences the path of its development and use (Barley 1986). Technologies are not simply passive and are never value neutral, but always exist in value-laden social and technical relations (Gasser 1986; Williams-Jones and Graham 2003).

Many have focused on the interplay between organization and ISs but lack explanation in where and how the interplay takes place and how one affects the other at a lower level of abstraction (Hanseth and Monteiro 1998). Research also suggests the need for bringing the IT artifact to the forefront (Hanseth et al. 2004; Monteiro and Hanseth 1995; Orlikowski and Iacono 2001) and clearly understand how it mediates change (Volkoff et al. 2007). ISs take material and functional forms during their interaction with the users (Akrich 1992). What is inscribed in ISs and "pre-inscribed" (Latour 1992) in the users, together the "script" (Akrich 1992), defines a framework of action together with the actors and the space in which they are supposed to act, which users may subscribe to or not. ISs explicitly delegate roles with specific competency, morality, and ethics to human and non-human actors (Callon 1991).

How this explicit delegation of roles works? Is it possible to delegate roles to human and non-human actors at the same time and why? This paper explores the dynamics of role allocation and its implications towards fulfilling the goal of implementing ISs in organizations and perpetuating actor-networks. The paper uncovers how actors' interests are reflected in the material and functional forms of ISs. It also explores the mechanisms used to perpetuate an actor-network. The following empirical questions guided this research: What interests of which group and anticipated program of actions were embodied and why? What was the role of the existed work practice in shaping ISs and future translations? How anticipated patterns of use have affected the adopting organization and vice versa, and the implications thereof?

The empirical material for this research comes from ART (antiretroviral therapy) clinics in Ethiopia. These clinics face challenges in manually collecting and collating data due to the requirement to collect large amount of data per individual patient, the requirement to duplicate them, the fixed format data collection and reporting forms, and the ever increasing volume of patients in a resource constrained setting (Mengesha 2007).

Computer-based IS plays an important role in alleviating these problems (Walsham et al. 2007). To this end, HISP¹ in collaboration with local and international partners, especially the

¹ HISP, which stands for Health Information System Program, is a network of health institutions and academics that has been operating in developing countries with the coordination of the University of Oslo. For more information on specific programs, see Braa, Monteiro and Sahay (2004), <http://hispp.org>, <http://www.hispindia.org> and <http://www.aau.edu.et/faculties/dis/site/hisp/index.htm>.

ART clinics and the Addis Ababa Health Bureau (AAHB), developed and introduced an open source (Bretthauer 2002; Hope 2004; McDonald et al. 2003; von Hippel and von Krogh 2003) ART system² in 2006. Even if four USA based Universities have the mandate³ to support the ART service other local and international partners were also involved. The interests of these partners to introduce computer-based solution to the data collection and collation challenge turned the environment to a center of competition and politics rather than collaboration. The phenomenon has shaped the design of the IS influencing the choice of development technologies, delegation of roles to human and non-human actors, subsequent translations, and durability of the actor-network. The existed ART practice also dictated the design of the system to follow its path and affected implementation in similar clinics. The nature of the computer system as an efficient data processing tool has influenced the distribution of roles to components of the network. These influences finally resulted in a suboptimal ART information system.

The paper is organized as follows: it discusses the theoretical framework and concepts used to explain the case in the following section. Then, it presents the data from the perspective of actors' interests, role delegation and scaling, following the presentation of the research methods. The last two sections present the analysis and discussion, and the conclusion, respectively.

THEORETICAL FRAMEWORK

This study draws upon the notions of Actor Network Theory (ANT) specifically it uses concepts such as actor-network, translation and program of action. ANT was born out of the interdisciplinary field of STS (Monteiro 2000) and helps us deal with the world of hybrid entities (Hanseth et al. 2004; Tatnall and Gilding 1999) made up of the social and the technical (Akrich 1992; Latour 1992; Law and Bijker 1992). ANT helps us understand the relationships between organization and technology (Hanseth 2005) by providing a language to describe how, where, and to what extent technology influences human behavior and vice versa at a flexible granularity of analysis (Monteiro 2000); it offers an approach to socio-technical change (Gao 2007; Walsham 1997). ANT adopts a "flat" ontology (Mutch 2002) and it has been the area of criticism which some authors refute to be an "unfounded claim" (Hanseth et al. 2004).

Technological artifacts are not exclusively the result of pure engineering and design processes but also are products of often conflicting views of the world (Bakardjieva and Feenberg 2002; Feenberg 2000). Technical objects are hybrid by themselves and participate in building heterogeneous networks that bring together actants of all types and sizes (Akrich 1992). Similarly, IS development in organizations involves tensions from different sources and events, circumstances, and unpredictable courses of action shape the trajectory (Cordella 2006). ISs cannot be designed from abstract markets in an asocial manner (Pollock et al. 2007). Designers closely work with users with an understanding that increased knowledge of users and the environment would lead to a better design. The design can also be affected by what exists, the installed base (Hanseth and Monteiro 1998).

² The ultimate target of the project was to realize an integrated HIV/AIDS management system that helps to manage a wide range of related services such as the management of voluntary counseling and testing, prevention of mother-to-child transmission, opportunistic infections, sexually transmitted infections, home-based care, ART pharmacy, indicators production, GIS provision, service mapping, referral linkage and TB functions.

³ Four Universities from USA such as the University of Washington (I-TECH), John Hopkins University (JHU), University of California (UC) at Santiago and University of Colombia have the mandate from the Federal government of Ethiopia to support ART related efforts in Ethiopia.

Different actors, both human and non-human, interact and influence one another while accomplishing tasks forming a web of relationships called actor-network (Holmström and Robey 2002). This actor-network links together the human and non-human elements (Callon 1986a; Callon 1986b; Callon 1991; Hanseth et al. 2004; Latour 1991; Monteiro 2000) which can be an actor-network by itself and/or part of another actor-network. The stability of an actor-network is preserved as long as all human and non-human actors remain faithful to the network (Whittle and Spicer 2008). The notions of inscription and translation are important to explain how actors' heterogeneous interests are aligned, and actor-networks are formed and sustained overtime (Callon 1991; Gao 2005; Holmström and Robey 2002).

Translation is a 'glue' (Williams-Jones and Graham 2003) that encourages actors that are independent and capable of resistance or accommodation to be involved in a network (Callon 1986b; Callon 1991; Latour 1991). Translation refers to the mechanism through which actors can transform themselves, displacing their own identity as well as that of others (Bruun and Hukkinen 2003; Callon and Latour 1981). The notion of translation implies definition and it involves a translator, something that is translated, and a medium in which that translation is inscribed (Callon 1991). In the case of ISs, designers translate the requirements of users into a computer-based solution, an inscription. Designers make hypothesis about the entities that make up the world into which the IS is to be inserted and make concrete judgments about anticipations and restrictions of the future patterns of use (Akrich 1992; Monteiro 2000). Akrich (1992:208) notes

Designers (...) define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of "inscribing" this vision of (or prediction about) the world in the technical content of the new object. I will call the end product of this work a "script" or a "scenario."

IS design, therefore, is an attempt to predetermine the settings that users are asked to imagine for a particular piece of technology and the "pre-scriptions" (Akrich 1992) that accompany it. Designers transform themselves into sociologists, moralists or political scientists at precisely those moments when they are most caught up in technical questions (Callon 1991). The resulting IS can be treated as a program of action that coordinates a network of roles envisaged by designers, which may be played by users (Akrich 1992; Callon 1991; Latour 1992). The embedded script or scenario of ISs explicitly define and distribute program of actions or roles to humans and non-humans and the space in which they are supposed to act (Akrich 1992; Callon 1991). Designers delegate to non-humans not only force but also values, duties, and ethics that makes humans behave ethically (Latour 1992).

The question is how is this explicit delegation of roles works? Law and Bijker (1992) and Latour (1992) suggest the delegation of roles to be carried out as a function of the effort required to perform tasks. An artifact such as a door can easily handle the task of creating and closing an opening in a wall than a person knocking down and rebuilding the wall each time, hence, to delegate the task of creating and closing an opening to a door than a human. It is useless to delegate tasks to artifacts or people if the effort of making sure that they perform as they should is greater than the original effort (Law and Bijker 1992).

Delegation of roles to components of a network prescribes a set of competency and knowledge and has a direct implication on performance. Delegating tasks to inefficient actors may jeopardize effectiveness and efficiency.

RESEARCH METHODS

This paper is the result of a case study (Yin 2003) conducted under an action research framework (Baskerville and Myers 2004; Braa et al. 2004). It adopted a qualitative research approach (Creswell 2003; Eisenhardt 1989; Klein and Myers 1999; Silverman 1998; Silverman 2005; Yin 2003) with the underlying epistemological and ontological notions of the interpretive philosophy (Orlikowski and Baroudi 2002; Walsham 1993; Walsham 2002).

The fieldwork for this research was carried out from March to August 2006, from February to April 2007 and from November to February 2008. The research employed interview, mostly unstructured, onsite observation, discussion and review of both electronic and print documents. Besides, the author of this paper has been a member of HISP and engaged in the development and implementation of the ART system.

The data collection was centered on understanding the practices of ART such as the management and coordination structure, the flow of patients and information, and the different forms and guidelines that were in use. It was also important to understand the interests of the actors involved and study the ART system development and implementation processes to understand the dynamics of role delegation and the embedded interests. The implementation data comes from clinics in Addis Ababa region where the system is implemented. The researcher has made onsite observations and discussions with ART clinic coordinators, staff of five Hospitals⁴ and three regional health bureau⁵ officials in charge of ART and reviewed various documentations of the FMOH (Federal Ministry of Health). Altogether, a total of 57 unstructured interviews and discussions were made as stated in the following table:

Specialization/Responsibility	Number of Respondents	Number of Interview
ART Coordinators	5	5
Physicians	5	5
Nurses	5	5
Data Clerks	8	12
Pharmacist/ Druggists	3	5
Laboratory Technologists	2	2
Regional Health Bureau Officials	3	8
Representative/Delegates of USA-Based Universities	2	7
Technologists	3	6
National HAPCO	1	2

Table 1: Respondents by Specialization and Frequency

During the interview and discussion sessions, the researcher took note and summarized the main points afterwards. The analysis centered on iteratively reading data followed by identification of key themes. There was a need for continuously going back and forth between

⁴ The Armed Force and Military General Hospital, Tikur Anbesa Teaching Hospital, Zewditu Memorial Hospital, Federal Police Hospital and Federal Prison Health Center.

⁵ The study included the Addis Ababa Health Bureau, the Amhara Regional Health Bureau and the Oromiya Regional health Bureau officials in charge of ART.

the designer and the user, between the build-in user and the real user, between the world inscribed in the object and the world described by its displacement (Akrich 1992).

CASE PRESENTATION

ART clinics in Ethiopia record the data of AIDS patients in Intake and Follow-up forms, and Pre-ART and ART register books. They report to various recipients using Pre-ART, ART, regimen, and cohort reports at different frequencies. Figure 1 depicts the contents and relationships of these data collection and reporting forms. The primary aim of the computer-based ART system developed by HISP was to automate the data collection and reporting forms depicted in the figure. The system accommodates the Ethiopian calendar, which is unique, and complies with (nationwide) standardized data collection and reporting forms and guidelines.

The ART system development and implementation directly and indirectly involved the standard ART practice, HISP, ART clinics, the ART system, AAHB and others. The health bureau was interested in immediately acquiring solution and HISP was interested to get into the market as quickly as possible and perpetuate the established actor-network by developing OSS-based ART system. The following sections present the interests of these actors, the role delegation processes, and the processes of implementation in other clinics respectively.

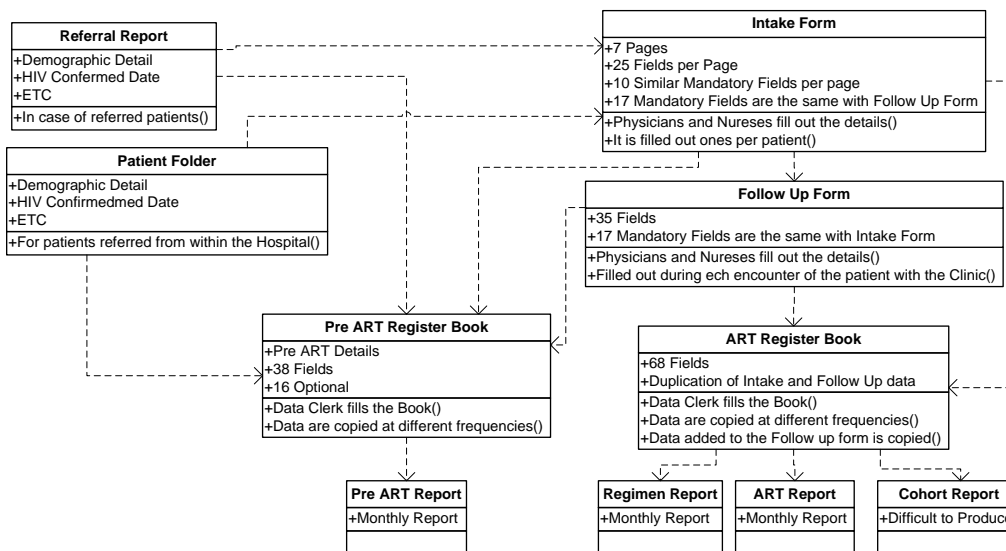


Figure 1 Dependencies among Data Collection and Reporting Forms of ART Clinics in Ethiopia

Actors' Interests

The USA-based Universities and others had identified a need to introduce similar solutions. Some individual and organization-based attempts were supported by the mandated organizations, people in the national HAPCO, and other organizations working in the area. Table 2 shows the characteristics of these actors and their interests in detail. Not all of these attempts and plans bore any fruit. In the meantime, HISP introduced an ART system into three clinics.

Afterwards, the AAHB invited other similar software for evaluation and the result declared the HISP's ART system as winner. The health bureau insisted on expanding the implementation in Addis Ababa despite the discontent of some people in the national HAPCO. The situation clearly indicated the possibility of introducing the system in Addis

Ababa and the challenge of getting acceptance at a national level. Besides, those who have the mandate were supporting other initiatives and must accept the HISP's ART system to deploy it in any region, since they were operating in all of the regions. One of the health bureau officials who tested a system developed by others and HISP states:

... we prefer to use your software than the one introduced by [the other actor]. We have seen both; yours has better functionality than the other one. Nevertheless, [the other actor] has the mandate in our Regional State to support ART... the agreement is made at the Federal Government level. ... However, we keep on discussing with the concerned people on this matter.

Actor	Description	Interests
Standard ART Practice	The FMOH has developed standard forms, guidelines, and procedures for collecting and collating data, and distributed to all ART clinics. Each clinic is supposed to comply with the national standard.	This standard practice needs to be preserved. The FMOH must approve any changes on the standard.
ART Clinics	<p>This group refers to the local practices of the ART clinics. The pilot ART clinic has changed the data collection procedure and introduced a new data collection form that has the same content with the existing forms with the aim to facilitate the data collection process and minimize the load of data clerks.</p> <p>Some of the patients do not have complete data recorded in all forms and the recorded data were incomplete. In some cases, the unique identifier was missing. Data clerks have been facing difficulties in collecting and collating data.</p>	The initial design of the system was confined to the pilot clinic's work practice and it dictated the new system to follow its practices. It also has affected the enactment of roles and their distributions to actors in the actor-network. For example, due to incomplete data, the task of data verification in terms of existence, domain, range and format was given to human beings and the computer at different times.
AAHB & Other Beneficiaries	<p>The (AAHB) Addis Ababa Health Bureau is responsible for allocating resources and monitoring the activities of ART clinics. Besides, it is involved in planning and decision-making processes concerning patients, the service, and ART in general.</p> <p>Other beneficiaries are those who directly or indirectly are involved in supporting ART such as donor agencies, the FMOH, WHO, etc. Getting accurate and timely information is crucial to discharge the responsibilities of this group.</p>	The AAHB and other beneficiaries were in need of a solution. For example, the AAHB was in need of identifying stable patients so that it can transfer them to health stations. Besides, they were not getting accurate information on time to make informed decisions and plans. The health bureau has resource constraints (limited expertise and finance) concerning system development and deployment.
HISP	HISP is composed of developers, researchers, and students tied together in a network of south-south and north-south collaborations. It has been working	HISP wants to immediately enter into the market and dominate it within a short period. Wasting time is

Actor	Description	Interests
	towards strengthening HIS in developing countries through capacity building, and software development and implementation. HISP develops the ART system and sets the stage for its implementation, and builds the capacity of developers and users at different levels through south-south and north-south collaborations. The Ethiopian chapter of HISP is based at Addis Ababa University, the oldest academic organization in Ethiopia.	associated to loosing the environment. The developers are students and they should finish their studies within the expected period. The identified needs of others to develop a similar solution were considered a threat. The base of HISP in Ethiopia gave the prestige and allowed the staff for participation.
The ART System	The ART system is the one mediating the network serving as obligatory passage point (Callon 1986b). The system is based on open source software license and technologies, runs on both standalone and networked environments and has web based interface. It is meant for supporting the data collection and collation processes.	The ART system was expected to alleviate the problems of data collection and collation. The goal will be realized only if the established actor-network is preserved.
Mandated Universities	The four universities from USA such as the University of Washington (I-TECH), John Hopkins University (JHU), University of California (UC) at Santiago and University of Colombia are mandated by the Federal government to support ART activities in Ethiopia. The activities of other collaborators are required to be coordinated with theirs.	They need to introduce their own system through either purchase or in-house development. One of the Universities had commissioned in-house developed system that addresses research purposes and it had a plan to develop one for the clinics.
Others	This category of actors includes organizations supporting other ART system development initiatives. Some of the organizations have influence at a federal government level.	They need to introduce other system than the HISP.

Table 2: Actors and Their Interests in the ART System Development and Implementation Network

Those who are from HISP state the following:

We have demonstrated our system to different regions at different levels. We have learned that our system satisfies the needs of these users. We have support from the regional health bureau and end users. Nevertheless, those who are responsible for supporting ART service at a national level and those USA Universities do not support us.... They are trying to develop and introduce their own system.

Meanwhile, HISP lost a bid to implement routine health data management IS across the nation despite its experience in implementing similar systems in the country. The environment shadowed by competition and the need for domination has shaped the design of the IS accordingly. For the sake of competition and showing the strength of the local capacity

and importance of the system, the developers introduced new functions that were not readily available in the manual ART system. For example, it included appointment management function and report/analysis generation capabilities that were not possible before such as identifying patients with a certain CD4 level etc. One of the health bureau official states the following concerning this matter:

I am very happy with the feature and functionality of the software. Besides, it does not involve us much cost.... Really it is very interesting to easily identify those patients who are stable using the system which otherwise could be time taking and cumbersome.

The system implemented OSS license and technologies. The developers' state:

Our system bases the OSS license and state-of-the-art open source technologies. Any ART facility can use it free of charge and we have been offering our services freely. We have a plan to upgrade our system to make it more robust in collaboration with our international partners.

The main agenda of HISP has been to strengthen the HIS of developing countries through capacity building and implementation of OSS-based ISs. Hence, the ART system implemented the OSS license and technologies such as MySQL, Apache and PHP. The use of OSS license allowed EFOSSNet⁶ (Ethiopian FOSS Network) to join the network. The system is web-based and runs on standalone and networked environments. HISP emphasizes the term "state-of-the-art technology" during any dialogue concerning the system as a result.

The ART clinics did not have computer networks. All clinics were running the system on PCs and they did not have an immediate plan for either networking or sharing ART data across physicians or clinics in real time. The PCs in all of these clinics run MS Office package and all of the data entry clerks have knowledge and experience of them. Some Data Entry clerks have developed applications with the help of MS Excel to prepare and maintain reports.

Role Delegation

The system was developed and tested in one of the ART clinics in Addis Ababa. The pilot clinic had several attributes to qualify for selection: it started the service before others; hence, it serves relatively large size of patients; data collection and compilation was difficult; it also had the experience of dealing with a similar but failed attempt; the staff had wider experience; etc. However, due to the age and patient volume, it has introduced unique data collection procedure that cannot be replicated to other similar clinics. For example, it started offering ART before the introduction of Intake-forms, and data has been recorded into Pre-ART and ART register books only from Follow-up forms. The clinic has piles of filled out Pre-ART and ART register books without corresponding Intake data.

Due to the pressure from AAHB for an immediate solution and HISP's interest to enter into the sector as quickly as possible, development of the ART system was confined to the pilot clinic. Consequently, the developers delegated the role of accepting data from Pre-ART and ART register books, and Intake forms to the system and that of populating the Pre-ART and ART Register books to human-users.

⁶ EFOSSNet stands for Ethiopian Free and Open Source Software network. Its mission is to create an environment that FOSS is utilized to enable better use of ICT for the sustainable development of Ethiopia. URL: <http://www.efossnet.org/>

Most of the manually filled out forms were incomplete; in some cases, the unique identifier was missing. Computer-based systems are supposed to facilitate accurate data collection by enforcing a variety of automatic checking mechanisms such as data existence, domain, range, and format verifications. Designing the system enforcing such validity checking mechanisms was not possible due to the incomplete data, i.e., those records with missing and wrong values, which are many in number, cannot be entered into the system. If not entered, the system may not be functional as intended and that was against the interests of the AAHB, HISP and the clinic. As a solution, the developers delegated the role of data validation – value existence, domain, range, and format – to data clerks rather than the system. The arrangement led to the establishment of a taskforce that cleans the data. Figure 2 summarizes the context, the dynamics, and the resulting ART system.

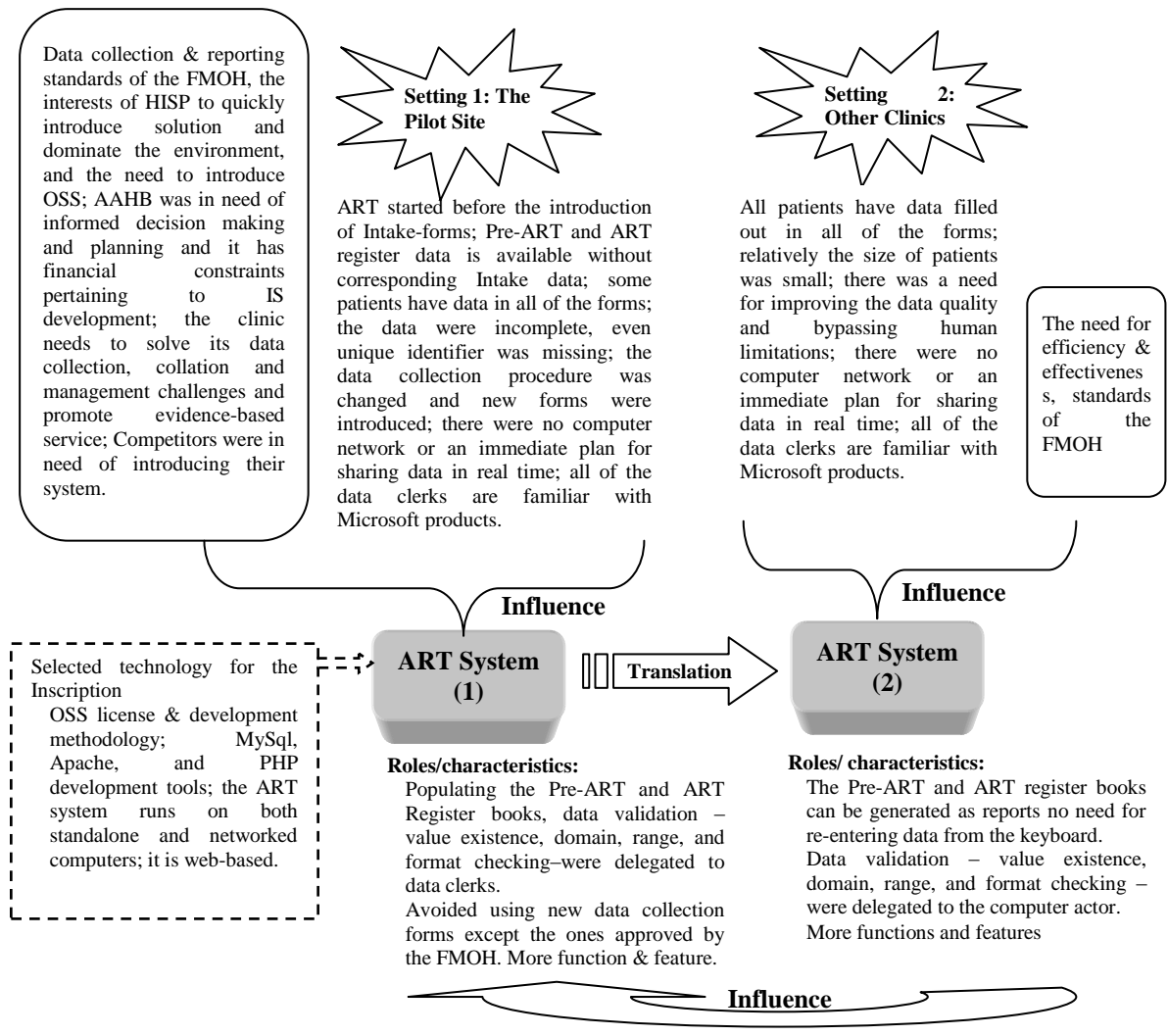


Figure 2: Graphical Representation of the Influences, the Translation, Roles and Their Interrelationships

The existing manual system had undergone changes on the standard procedure of data collection and introduced new forms. For example, the Data Clerk was supposed to copy details of a patient directly from the Intake and Follow-up forms into either Pre-ART or ART register books. Due to the size of patients, it has become difficult for the Data Clerk to go

through all the Intake and Follow-up forms of every patient and copy the data into Pre-ART and ART Register Books. To solve the problem, the clinic has developed an abridged version of the Follow-up form. The new arrangement dictates Physicians to fill out both forms with the same data.

Even if the data entry procedure did not have any effect, the introduction of an abridged version of an existing data collection form has affected the design of the IS. The abridged version was more convenient to collect and enter data into the system than the original but not supported by the standard. Therefore, for the sake of developing a system that meets the needs of the standard data collection format, the system was designed according to the national Follow-up form, not the abridged version.

Scaling

When the system was implemented in another two clinics – Federal Police hospital and Federal Prison health center – it was found out that their procedure was different from the pilot clinic. Hence, there was a need for re-designing the system to align with the new context. Those ART clinics that started ART after the introduction of Intake forms no longer needed to enter data into ART and Pre-ART register books from the keyboard. The sources of data for the register books are the Intake and Follow-up forms (Fig. 1), once data from these sources were entered into the system, there was no need for re-entering the same data again. Rather than entering data from the keyboard into the Pre-ART and ART register books, these can be generated as reports. Hence, the system was modified to reflect the new situation and it delegated the role of populating Pre-ART and ART Register books to the system itself rather than to data entry clerks.

This situation demanded changing the original design of the system at the pilot site. For new patients and patients that have Intake data, there was no need for reentering the same data again in the interests of data accuracy and bypassing human limitations.

The ART clinics in the new sites started ART relatively recently and they had less than 100 patients on ART. In these cases, the developers delegated the role of data validation to the computer system because, if there were incomplete or invalid data it was relatively easy to correct them. In new ART sites, it is possible to delegate the role of validating values to computers. Even if this procedure facilitated data entry and improved data accuracy, it did not impact the design of the IS at the pilot clinic.

ANALYSIS AND DISCUSSION

The ART system has brought together human and non-human actors of different size that had profound effect on the choice of development technologies and functions. The system entertained conflicting views and interests of various groups, and was the center point of competition and politics rather than collaboration. This section analyzes and discusses the data from the viewpoints of inscribed interests, the program of actions, and translation, and their relationship towards fulfilling the goal of IS implementation and future trajectories.

Inscribed Interests and Future Trajectories

The choice of development technologies, the use of OSS as a license and development methodology (Feller et al. 2005), enabling the system to run on both standalone and networked computers, and the web based feature are manifestations of the interests of the dominant actor (Law and Bijker 1992). The dominant actor is the one that is able to insist upon its definition of both problems and appropriate solution.

The idea of OSS development was not mature enough in Ethiopia. Nevertheless, despite the debate concerning relevance and cost implications of OSS to developing countries (bridges.org 2005a; bridges.org 2005b; Feller et al. 2005; McDonald et al. 2003; Morgan 2002; Weerawarana and Weeratunge 2004; Wheeler 2005), the license helped to build coalition among local and international partners. The capacity development strategy of HISP such as capacity development at different levels, empowering users and networking of actions (Braa et al. 2004) in south-south and north-south manner reinforced the entry into the ART domain and sustain the network.

The use of the political card “state-of-the-art system” gave an opportunity to HISP for selling the product and gaining support despite the reality of beneficiary clinics. The beneficiaries do not have networked computers or an immediate plan for sharing data across physicians or clinics in the real-time. However, the system requires all of these technologies installed on PCs to run smoothly which might have negative implications on the speed and storage spaces considering the developing country context. This phenomenon shows the transformation of actors including developers into political scientists and sociologists (Callon 1991) to assure the viability of the system.

The system can be developed using Microsoft technologies, which were quite familiar to users and were in use in all ART clinics. However, due to the existence of competitors, the whole mission was targeted at excelling others by using “better technologies” and “suitable ideology” and proving the capacity of local developers through feature and function additions and yet demanding no cost both for the system and associated services.

The system inscribed not only the current patterns of use but also specified future directions. Web-based applications are state-of-the-art and the way of the future, and ART services benefit more if physicians have online access to patient data irrespective of location with the support of analysis and visual tools which the system has already inscribed. The selection of any system in the future is locked-in (Hanseth and Monteiro 1998) not only to the technical compatibilities such as network, database, and interface of the system but also to the ideology of OSS.

Program of Actions Enactment and Distribution

The existed practice of the pilot ART clinic expressed its interest in terms of retaining its routines (path dependency (Hanseth 2004)). The initial design of the system delegated roles according to the context of the pilot clinic. Due to the need to proceed with implementation, the developers delegated tasks that a computer system handles more easily and accurately to humans. Later on however, some of these tasks were delegated back to the computer system. Here the non-humans have influenced the delegation of roles similar to human actors.

The case reveals that role allocation is not a function of the effort required to perform tasks as pointed out by Law and Bijker (1992) and Latour (1992). Computers are superior to humans in consistently and efficiently carrying out tasks such as validating data availability, domain, range, and format (Kling 1980). However, for the sake of perpetuating the socio-technical network, this particular role was delegated to humans despite the difficulty and the problems thereof. Therefore, it is possible to say that roles allocated to components of a network may not be a function of the effort required to perform them.

The developers did not consider some contextual factors such as using the newly introduced form in the pilot clinic in the interest of the national standard that had political significance. The success of any system was tied to its adherence to the national standard as stated previously.

Translation

The translated version of the ART system (Figure 2) followed the “effort” logic while delegating tasks. The original design was modified so that it automatically generates Pre-ART and ART register books and validate data. From this viewpoint, it is possible to generalize that the same task can be delegated to human and non-human actors at the same time in different contexts. Role delegation involves not only delegation of force but also values, duties, and ethics that implies competency. Human and non-human actors do not have the same level of competency and delegating the same role to them is problematic. However, the resulting sub-optimal system (Gasser 1986) perpetuates the actor-network as shown.

The dynamics of role allocation was crucial to sustaining the network and the implementation process. However, it might have negative implications towards achieving the goals of introducing computer-based systems. For example, making the system to accept Pre-ART and ART register books from the keyboard duplicates data. Besides its impact on storage space, retrieval speed, and related database management challenges, it demands additional resource for verifying and entering data. It is inconvenient to generate reports because it is challenging to choose between the register books, and the Intake and Follow-up forms as sources of reports.

Besides the duplication, the problem of accurate information generation is aggravated due to lack of appropriate data validation mechanisms. Due to data collection errors the two data sources can exhibit differences and may produce different reports. Considering sensitivity of the health environment, delegating tasks to inefficient actors may aggravate the problem rather than solving it. The system might end up being multiplier of wrong data. Therefore, as one of the core aspects of IS, roles are required to be carefully allocated to components of a network otherwise it might fail to serve the purpose. System development, besides negotiating local interests, should pave way for “generification” (Pollock et al. 2007) of translations in cases like the ART system where there are standardized data collection and reporting forms, and procedures across the nation.

CONCLUSION

This paper demonstrates how an IS acquires its material and functional forms by attaining to the various influences overtime. The paper shows how interests of actors in the socio-technical network were translated and appropriated over time, and the roles of the installed base and the interests of actors' in enacting program of actions and their distributions among components of an actor-network. The paper also reveals that certain program of actions can be delegated to inefficient actors despite their implications on the performance of the IS. It also shows the strategy used in order to establish and perpetuate the socio-technical network such as the use of OSS license and development methodology, the promotion of the south-south and south-north network of actions, the flexibility of delegation of roles to components of the network, the capacity building strategy, and the ability and capability of function and feature additions.

The paper also indicates how the ART system was not just a tool that minimized the problems of data collection and analysis. It showed the ART system as a tool that embodied and indicated the future behavior and structure of ART clinics, that dictated the nature and type of technologies, tools, and ideologies to be followed, and became the central point of competition and politics. The system has already specified the type of environment it will be running in the future and the functions it can provide to current and future users.

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