

## Globetrotting health information systems

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### Abstract

Cases from an international network, active in health information systems development and implementation in “developing countries”, are presented in order to show a variety of interplays between the same IT agency and varying local settings. By using the same institutional lens, a theoretically informed view of empirical data is provided. Trajectories of implementation in Ethiopia, Botswana, and India present two different, and often diverging, levels of contextualization of the IT artefact: in the local context and in the (possibly emerging) organizational field of health information systems in “developing countries”.

By discussing the emergence of an organizational field of health information systems across “developing countries”, but so far not showing many traces of isomorphism, this paper aims at enlarging the empirical basis of what is considered relevant in information systems research.

**Keywords:** *health information systems, developing countries, New Institutionalism, India, Ethiopia, Botswana*

### 1. Introduction

Our proposal is to adopt an institutional lens to look at cases from developing contexts in order to shed some new light on how IT artefact adapt -or not- beyond the empirical settings where they are usually studied. In this way, we aim at blurring a common separation between research on information technologies in developing and industrialized countries, also theoretically. ‘Development’ is a normative concept whose meaning is rooted in the idea of ‘progress’, which has been tied to new technologies and organizational forms. Development has provided an analytical lens to look at most of the world, and conceptualized possible solutions. This stance created the common understanding that development problems are “out there”, rather than the product of a specific world view, originated from a specific context. Surely, it is not our intention to deny the existence of those problems, but we propose to re-think the way IT based development issues are constructed and acted upon in relation to contexts where usual assumptions cannot be taken for granted.<sup>1</sup>

With that aim in mind, we describe the case of the Program on Health Information System (a pseudonym, ‘PHIS’ henceforth), which acts as institutional entrepreneur<sup>2</sup> in a variety of settings. We start by reflexively re-defining the agency<sup>3</sup>. Common sense suggests that an agency conceptualizes a problem, therefore proposes a solution. We see how a set of solutions, which can be provided by an IT agency, define the agency and its conceptualization of the problems. In other words, we present how the agency sees the problems to deal with depending on what solutions can be provided. Later, we describe how consequent activities are translated through a variety of institutional settings. By describing significant interplays, we draw some conclusions about interactions between IT agencies -with their global outreach- and the heterogeneous institutional settings ‘crossed’ by them. This paper presents a theoretically informed and empirically rich account of how the same IT-based agency is shaped by a variety of institutional settings where it is active.

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<sup>1</sup>Noir and Walsham [2007, p. 314] summarize clearly this point. Our aim is to extend Ferguson [1994] and Escobar's [1995 and 1998] constructivist arguments, both on Foucault's line of thought.

<sup>2</sup>On this line, one of the authors, in a paper in progress (Feb 2007) writes “The notion of institutional entrepreneurs helps to understand both the creators and carriers of institutions, and refers to “the activities of actors who have interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones” (Maguire, Hardy and Lawrence, 2004: p. 657)”. Hence, institutional entrepreneurs are “those actors whom the responsibility for new or changed institutions is attributed” (Hardy and Maguire, 2007: pp. 1). Actors are considered to be human or non human for example, regulative institution (such as national ICT policies, strategic documents) and cognitive institutions (such as individual perceptions and beliefs) (Scott, 2001) that emerge within the organization and the broader organizational field.”

<sup>3</sup>Here we rely on a simple meaning of ‘agency’: with this term, we refer to who (or what) performs an action. At different levels of granularity, agencies are produced by networks of relations.

The cases presented are from a global network dedicated to health information systems design, development and implementation. We introduce the agency to focus on, its international outreach, and its modality of action in a first stance. Through the paper, we distinguish between:

- a) PHIS (the international action-research network), which develops and implements,
- b) HIS, which refers to the technical aspects of the information system.

When we refer to health information systems in general, we do not use the acronym. Then, its interactions and adaptations in different settings are presented in institutional terms. A simple scheme is used for the description of empirical data from Ethiopia, Botswana, India (Gujarat and Kerala states). The cases show how the same agency produces different outcomes when it enters in interplay with different institutional settings, with their own constraints to organized action and technology use.

## 2. Research framework

In order to approach this set of issues, we assume that aiming at isolating the IT artefact is futile, if not counterproductive for the understanding of these phenomena. Indeed, from our cases, it is hard to distinguish IT artefacts from the organizational aspects. More thoroughly, we rely on an institutional perspective to relate institutional entrepreneurship with processes of institutionalization of health information systems in different countries. We find King et al.'s words (1994, p. 141) quite clear in motivating our theoretical choice:

*The goal of incorporating institutions is to bridge between amorphous social concepts such as "society" and "culture" on one hand, and more specifiable and tractable social entities such as organizations, firms, groups, and individuals on the other. Institutions form the vital boundary layers between these two worlds of discourse.*

Two basic concepts of Neoinstitutional theory have to be introduced: 'organizational field', which denotes the frame of reference of organizations engaged in a specific activity, and their interactions constituting a recognized area of activity. Powell and DiMaggio (1991, p. 65) add that "the structure of an organizational field cannot be determined a priori but must be defined on the basis of empirical investigation". That is a crucial aspect of our contextualization effort. The second, and related concept is 'isomorphism', which refers to the trend towards similarity among organizations under similar constraints; it can be normative, coercive and mimetic (DiMaggio and Powell: 1983, p. 150).

Traditionally, one of the purposes of action-research is to improve people's conditions. In accordance with this research approach, research stance and questions have to be stated. The authors move from a reflexive view of PHIS which acts as an institutional entrepreneur (providing information

services, finding and managing resources, conducting graduate programmes,...), to look at different trajectories of health information systems development and implementation. Both sides of the analysis -the international agency and implementations in different settings- are based on participant observations in a first stance, as most of the authors have been involved in participation in PHIS projects within a frame of action research. Direct involvement took place at all levels of PHIS activities, from global software development, to local implementations in different countries, including capacity building initiatives. Other data originated from interviews and documentary studies on the material provided by public administrations and produced by the PHIS.

Our main research questions are:

*How does PHIS conceptualize its fields of action?*

And

*How does PHIS interplay with different institutional settings?*

A simple analytical schema based on institutional theory has been used to highlight similarities and differences between the cases. Scott (2001) states that "institutions are multi-faceted, durable social structures, made up of symbolic elements, social activities, and material resources." So, all authors have used the following scheme for each case description:

Social activities

- What were the activities that PHIS affected and was affected by?
- How?

Material resources

- What economic, technical, human resources served for system development and implementation?
- How were they used?

Symbolic elements

- How were PHIS and the HIS seen by main stakeholders (officers, government, health personnel...)
- What were the expectations from PHIS and HIS?

We also considered the Madon et al.'s (2007) scheme for institutional analysis of multiple cases of IT for development:

- getting symbolic acceptance by the community;
- stimulating valuable social activity in relevant social groups;
- generating linkage to viable revenue streams; and
- enrolling government support

Even if we agreed with Madon et al. who state "rather than building a framework for evaluation which focuses solely on impact, we suggest the need for approaches which try to understand key institutionalisation processes over time, and which document these processes in some detail", we found their scheme too punctilious for the data we had available.

<sup>5</sup> A common set of tools for FOSS development includes mailing lists, wikis, source code repositories and others, see Fogel (2005) and Lanzara and Morner (2005).

## 3. Presentation of cases

### 3.1. The global network

The PHIS is an action research network involving universities, public health authorities, and non-governmental organizations. Started in South Africa as a collaboration between a Norwegian and two local universities in the mid nineties to support the restructuring of the health system post apartheid, by 1999 it was rolled out in all districts in the country, and the software and approach were subsequently introduced in several other African and Asian countries.

#### 3.1.1. Symbolic Elements

The vision of PHIS is:

*"[...] to support the development of an excellent and sustainable health information system that enables all health care workers to use their own information to improve the coverage and quality of health services within our communities"* (Williamson et al 2001).

One of the basic principles was decentralization and empowerment of health personnel and decision-makers. Participation and bottom-up approach were guiding principles, based on the Scandinavian Participatory Design tradition, 'cultivated' into developing country contexts<sup>4</sup>. Under the slogan "information for action", the general goal was "to provide useful information for management at each level of the health services" (Sauerborn and Lippeveld 2000). On the governments and funding agencies' side, PHIS promises an improvement of the health care delivery through the support of use of reliable information for decision-making.

The first version of the HIS was developed by a small team of developers in South Africa on the Microsoft Access platform, which was well established by the mid-nineties. The system was designed to be configurable without great technical facility, and was provided without charge, including source code. However, the emergence of the internet made this platform seem outdated after the turn of the century, in comparison with web based applications. These concerns were expressed forcefully by an independent consultant in 2003, and by the end of that year work started towards a fully revamped version 2.0 of the system. A team of researchers and graduate students in Norway set out to address a range of both practical and symbolic issues which had accumulated since the inception of the network, including building technical capacity and distributing the development to other nodes in the network.

With the new version, prominence was given to platform and vendor independence, which was closely linked to the use of free and open source software (FOSS), which resonated well with the PHIS narrative of sharing and openness. At the same time, a lot of emphasis was put on adopting "cutting edge" programming frameworks and tools, adherence to standards, as well as the use of a "modern", modular and layered architecture which would allow for flexibility and local customizations. Most of these aspects were promoted and operationalized through choice of specific technologies and adoption of best practices with

regard to FOSS processes<sup>5</sup> by the new developer team as a basis for the core of version 2.0.

#### 3.1.2. Social Activities

From the beginning, PHIS focused on "how the existing centralized information system and standards present obstacles to change" and "how a new decentralized information system may institutionalize new work practices" (Braa and Hedberg 2002, p.116). A key activity was to translate health work practice into Essential Data Sets (EDS) used to calculate and report key indicators for decision making like immunization rate. This aimed at streamlining the collection of data and lessening the burden for health workers through avoiding duplication of data, and increasing the quality and value of the information for use at all administrative levels.

Throughout, activities took place along two main lines: improvement of public health and technological development (both involving capacity building). The balance between these two elements varied considerably between settings. The network linked governmental organizations, researchers and students from different research centres in a number of countries, aiming to integrate action research, education and social change in the health sector in the development and implementation (Sahay 2001). The education component was operationalized through the establishment of joint masters and doctoral programs in Health Informatics.

It took time for the Norwegian team to establish a robust base for the new version of the software, and the range of modern FOSS tools was mostly unknown to the developers in the other nodes, with e.g. the Indian team expressing frustration at not being able to take part in the development process because of the radical shift in technologies and process and accompanying steep learning curve. This was mitigated to some extent by prolonged visits by core developers to India and travel by Indian staff to other nodes, but remained a problem long term. The switch to FOSS, and the aim of mobilizing a large community of developers from all parts of the globe, shifted also the previous balance of PHIS action between public health and technology development towards the latter.

#### 3.1.3. Material Resources

Funding for the project came mainly from research agencies, donor organizations and local health authorities, and was used for travel between the nodes for workshops and prolonged stays, for doctoral and master scholarships, for hiring personnel to help in software development and local training and implementation, and to a limited extent for computer equipment.

Though the new version was explicitly developed as a web application, the network infrastructure in most implementation sites was not adequate to support server based data entry and analysis. The developer team was well aware of this fact, and designed the system to be able to run on a standalone computer as well, but the installation process was relatively complex, involving a number of separate software components, and thus trained technicians in short supply were required

<sup>4</sup> For an overview of Scandinavian Participatory Design research, see Bødker and Grønbaek (1991). Dahlborn and Mathiassen (1993) introduce the concept of 'cultivation' of information systems.

<sup>6</sup> "Java Platform, Enterprise Edition (Java EE) builds on the solid foundation of Java Platform, Standard Edition (Java SE) and is the industry standard for implementing enterprise-class service-oriented architecture (SOA) and next-generation web applications." <http://java.sun.com/javasee/index.jsp>, accessed 2008-05-27.

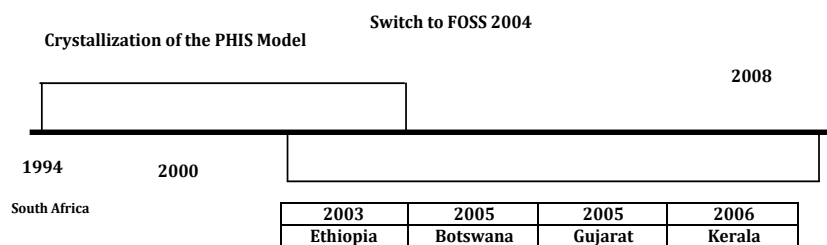
<sup>7</sup> A number of up-and-coming (and increasingly mainstream) open source J2EE frameworks were selected, among them Hibernate, Spring, Webwork and JUnit.

to implement the system. Not until the fall of 2007 was a simple, "click-through" installation package assembled.

Hiring programmers with experience in the toolset deployed by for the new version of the software proved difficult in the countries in the South, with the training of students and recent graduates the only viable, long term option. Furthermore the lack of broadband internet connectivity and the accompanying lack of facility with the web based collaborative tools and processes strongly promoted by the core Norwegian team hindered distribution of the development effort. Additionally, the available developers in the Southern hubs were much less familiar with web application development, which involves different complexities and an emphasis on layering.

### 3.1.4. Points from the Case

Through these years and experiences, and mostly through its first decade, PHIS' pattern of action consolidated into a model which is followed in all implementation, as showed in the graph below.



The main stages of implementation model are:

- 1) Initial contacts with health care authorities
- 2) Situational analysis and assessment of health information systems
- 3) Customization of HIS
- 4) Start of a pilot implementation
- 5) Training
- 6) Scaling up of HIS and aiming at institutionalization

This model inscribes the principles and experiences of PHIS, and describes its approach in respect to the fields where it is active. Besides being rooted in previous experiences and reinforced by new implementations, the model kept quite stable across time and space because of the common readings of academic participants (also codified in university courses), informal relations across the networks, as well as a shared sense of what the network is about and how it operates. A similar, and largely congruent model has been presented by Madon et al (2007, p.12). It is important to note that the aimed source of legitimation is in local contexts, but -by replicating efforts in different countries- a tendency to stimulate the emergence of a health information systems organizational field throughout the South can be perceived.

More on the technical side, the elements introduced by the transition to FOSS provided affordances (Norman 1990) and narratives which proved of great value in several contexts, but were obstacles to progress in other cases. Rules

and constraints which worked as obstacles in the local implementations acted as affordances helping to establish relations across a variety of settings. The choice of a solid and well established "enterprise" programming platform<sup>6</sup>, as well as modern, lightweight and increasingly mainstream frameworks<sup>7</sup> afforded the collaboration with World Health Organization (on OpenHelath) and OpenMRS, both technically and symbolically.

Through the following cases we present the alternate fortune of the PHIS implementation model, and the progressive switch to an approach more rooted in high organizational levels.

## 3.2. Ethiopia

The health care system in Ethiopia started decentralization in 1993, giving regions considerable autonomy on health decisions. In 1997, the Government launched a twenty-year health development implementation strategy, known as the Health Sector Development Program (HSDP), with a series of five-year investment programs.

The health service delivery system in Ethiopia is organized in a four tier system: Central and Regional Referral Hospitals, Zonal/District Hospital, Health Center and Health Post. Central Referral Hospitals give referral service to patients from the regions, and the regional ones. Zonal/district hospitals are expected to serve a population of about 250,000 people, including the admission service. Health centers provide both curative and preventive out-patient care to about 25,000 people and health posts are the smallest health units staffed with two Health extension workers serving 5,000 people with focus on the preventive care.

### 3.2.1. Social Activities

The PHIS project in Ethiopia started in 2003 as a collaboration between a university in the capital and a Norwegian one. Part of the collaboration involved Norwegian agencies providing scholarships for PhD and Master students in exchange of practical contribution from these students in implementing and improving a health information system in the country. It was a research and development project guided by the universities rather than a program carried out by the Federal Ministry of Health.

PHIS approached the Ministry of Health with the argument that poor data quality could not support a proper management of health activities. An in-depth analysis conducted by members of PHIS Ethiopia pointed out major restraints on the existing HIS that included problems related to data collection tools, basically manual and characterized by high fragmentation, cumbersome data elements with duplication of efforts; generating poor data quality. Although the Ministry agreed that problems related with the health information system in the country existed, they could not accept to work together with this initiative for two basic reasons. First, the HIS was based on a proprietary database management system which was considered by the ministry technologically inappropriate for a national system. Second, the ministry addressed the national strategic plan for ITs as a prerequisite for any implementation in the sector. This plan proposed the development of a new national health

information system. Consequently, PHIS began to collaborate with Regional Health Bureaus such as Addis Ababa, Amhara, Tigray, Benishangul-Gumuz, and Oromia.

The effort of PHIS Ethiopia, in collaboration of the health bureau staffs, started at Addis Ababa, and mainly included standardization of data collection tools; customization and implementation of the HIS; training, and support. Although considerable effort was made to avoid duplication in data collection and to develop uniform reporting formats, full-fledged change could not be sought in the standardization process of data collection tools as there was missing linkage between this effort and the Ministry of Health.

In 2007, the HIS implementation in the regions has been terminated by the Ministry of Health, which is currently under national health information system reformation process. despite the regions' constitutional autonomy and decentralized approach in the health care sectors. This reform will define new national reporting formats and also new software. So far, the standardized reporting formats and the Master programs which started by PHIS are still going on.

### 3.2.2. Material resource

Initially, PHIS in Ethiopia was funded by the Norwegian Embassy in Ethiopia through the Norwegian university. In addition to the project's direct expenses, funds were also used as PhD and Master students scholarships. The respective health bureaus provided computers, papers, offices, and human resources for the project in their own regions. Ethiopia received other funds from the European Union, that were used to employ ex master students employees.

Relatively heavy investment was made in building the capacity of health staff by various training sessions. Providing computer skills was crucial as many of the health workers did not have any previous experience with computers. In addition to the scheduled training sessions and distribution of guiding manuals, users were provided with on-site support. In order to facilitate the capacity building effort, the project employed facilitators for each health bureau. As a long-term capacity building effort, a Master Program in Public Health and Informatics were started. These programs intended to complement the curricula of health professional who graduated from schools focused on clinical issues. The capacity building activity done by the Master Program mainly targeted Health Bureau staff. Graduate students are expected to return to their regional health bureaus and contribute to the improvement of the region's health information system.

### 3.2.3. Symbolic Elements

Some symbolic elements showed the acceptance of PHIS in the regions. For example, one of the regional health bureau officials said: "Information is power for everything. We have problems on this part, so, as you are here to improve the health information system of the region, go-ahead" (Amhara Region Health Bureau, January 2004). Some local funding also had symbolic relevance of acceptance of the project. The reasons provided

included: first, the regions' expectations on IT to improve the situation of existing problems led to the beginning of the reformation work done by PHIS. Second, the project's affiliation with a renown local university and the involvement of an international university made the project to be perceived as credible and reliable. Third, the project started in the capital; this increased the interest of other regions to use HIS and thereby eased the scaling up process.

### 3.2.4. Points from the Case

In this case, the trajectory of the essential dataset is quite significant as it affected the health care system beyond the information system embedding it. Also, extensive capacity building was carried out at local level about the use of HIS. In spite of these efforts, the national level of the health system, and some of the local governments did not accept HIS. As the project was explicitly an action-research project, the academic side has remained more disconnected from the local contexts. So, graduate students are now on the international research side, but in loose relation with their original empirical context. More generally, we can state that this case showed a misalignment of local and international legitimations.

## 3.3. Botswana

The public health service in Botswana is highly fragmented both across ministries and within the Ministry of Health at national level. While the Ministry of Health runs the different health programs nationally, it is the Ministry of Local Government which runs health service provision in the districts, thus there is a horizontal ministerial gap between national and local level.

At the national level, there are five ministries involved in the data collection. The Ministry of Health runs most of the health programmes at the national level while the Ministry of Local Government is responsible for health service provision and all administration at district level. The Ministry of Communication, Science, and Technology is responsible for all IT activities, including computerized HIS. The Ministry of Financial Planning is a user of health statistics, which they get from the Central Statistics Office, which has seconded the Health Statistics Unit to the Ministry of Health for data collection. Lastly, the Botswana Defense Force runs some of the clinics.

### 3.3.1. Social Activities

The social activities that constitute PHIS presence in different settings are highly diverse, but follow similar patterns at the same levels of different organizations. At facilities, nurses and doctors are responsible for documenting activities related to health service provision. The figures for these activities are aggregated monthly and reported to the district offices and upwards. Most of the health programs are supposed to get their data indirectly from the same central office, but because of chronic delay in collecting such data, health programs have made their own systems, some relying on ITs, some on paper.

Given this fragmentation, a project to provide a data warehouse as an integrating platform for health information was initialised in four pilot

projects. However, it faced many obstacles. The project started in 2005, with the establishment of 4 pilot districts (out of 26), adoption of local collection tools, and training of district and national personnel. However, the IT department within the Ministry of Health, which was leading the efforts in Botswana, was solely staffed by IT professionals, none of which had a background in public health administration or health in general. Thus, as the project went ahead, it was increasingly seen as a purely technical project by both the project owners and the health staff working in the districts and Ministry. The project staff focused on technical problems, such as computer virus and hardware challenges, while the health professionals saw the project as merely introducing computers, rather than helping them to improve health information systems.

### 3.3.2. *Material resources*

In terms of material resources, Botswana is unique compared to the other countries presented in this paper. Comparatively, it is rich, with a GDP per capita of 14,700 USD (CIA Factbook 2007 estimate). The project coordinators were repeatedly told that “money is not a problem” by the Ministry of Health. The implementation costs were covered jointly by PHIS itself and the Ministry of Communication, Science Technology at national level and the Ministry of local Government at district level. However, a main challenge is the lack of skilled personnel. Being a small country of only 1.7 million inhabitants, Botswana has until 2007 lacked a medical faculty. Health professionals are hard to find, and the large wage gap between private and public sectors are draining all public institutions of IT-skilled staff. High turnover of staff is a major problem in Botswana.

Extensive training courses were held both at the project initiation in 2005 and before the national roll-out in 2007. However, most people trained in 2005 had either changed positions within the public health sector, or moved to the private sector, by the time the EU project was terminated in 2008. The most able health managers in the districts would get positions at the national level, while IT-professionals would seek employment in the private sector, understandably attracted to wages four to five times higher than what the public sector could offer. This intra-national brain drain, from districts to national level, and from public to private sector, consistently undermined progress by “skimming the milk”, removing the project staff with exceptional skills or motivation.

### 3.3.3. *Symbolic elements*

The symbolic value attached to computers and the project ownership by the IT department should not be underestimated. The health programs, such as Maternity, Home Based Care, and Health Statistics Unit increasingly distanced themselves from the project, and the IT department did not actively pursue involvement from them. Another important symbolic element is the hierarchical attitude at the IT department: this led to different intensity of cooperation according to the title of who was present. The project was funded by the European Union, a fact that was often stated by the project staff when approaching health programs or other stakeholders. The symbolism carried

by the EU-tag was a strong force in negotiating participation from many of the actors. The same force was experienced when the project eventually became affiliated with UNAIDS and the National AIDS Coordination Agency, which has more political leverage in a country highly committed to tackling this disease. Both EU and UNAIDS became door-openers just by their symbolic representation in the project.

### 3.3.4. *Points from the case*

The lack of coordination at national level had led to a multitude of parallel information systems in the health sector, compromising data quality and sharing. A project to address the current fragmented health information systems was set up, but faced challenges that relates to symbolic elements of the institution. The project was set up within the IT department of the Ministry of Health, supported by the EU, which led to the process as being technology driven; an IT project more than a health information project. Combined with the IT personnel's lack of public health background, the project team and the groups within the Ministry of Health it was supposed to support, drifted apart as project activities were perceived as entrenched in IT sphere. Only with the collaboration with UNAIDS later did the project gain sufficient health legitimacy, starting a process of integration that is picking up pace at the time of writing. For these reasons, here we can find a weaker emphasis on local legitimation. Urgency of data duplication and fragmentation's reduction, data warehouse as a solution, imply a stronger link with the general priorities in information system development.

## 3.4. Gujarat

Gujarat state is located in western India with an estimated population of about 50 million according to the 2001 census. The state is administratively divided in Districts. Following, are the Block Health Offices (BHO), which coordinate administration tasks at the sub-district level, and between the levels of the district and community, including activities around health information systems. The state public health care system is constituted of 1070 Primary Health Centers (PHCs), 253 Community Health Centers (CHC) and a few thousands of Sub-Centres (SC), usually situated at the Taluka (sub-district) headquarters.

### 3.4.1. *Social activities*

After being approached by an IT consultant in the Gujarat Health Department, PHIS India was invited to customize and implement HIS. It has been implemented from February 2006 until April 2007 in a bureaucratic context where use of information for planning and action, as well as the sharing of information, were rare. During an interview, one of the vertical programme managers (like Malaria, TB, HIV/AIDS prevention and control programs, etc) declared that “we [the health program managers] have the population in common, only.”

The implementation of HIS followed the local existing information flow because it was thought to be the best way to get acceptance and organizational change would be introduced incrementally. In PHIS India project, the computers were placed at the BHO, as all the Primary and Community Health Centers came to the BHO for

their information processing activities (including data entry and report generation). So, each level aggregates data from the lower one, adds new data and produces its own reports as per predefined national formats. The underlining PHIS strategy reflected the experience of the PHIS global network: starting pilots at the district level, customizing the system, then scaling up. The project implementation started with a pilot in the southern part of the state. In July 2006, a positive evaluation (by the state authorities and a prestigious national management institution) allowed the scaling up of HIS to five more districts in the northwestern part of the state. Through 2007, all the 25 districts in Gujarat were expected to use HIS. For different reasons (IT consultant left post, other IT companies entered the scene, lack of capacity at facility level) the implementation was stopped in April 2007, and a government agency was assigned the task to develop and implement a new system across the state. In August 2007 (after a change of Health Commissioner), PHIS was contacted by state authorities to consider its redeployment.

PHIS implementations had established the premises for further development of the system, also by incorporating additional features. Two examples are a graphic analyzer (a 'dashboard' of managerial indicators) and a geographical information system. For the interoperability of the HIS with spatial data, due to the scarcity of resources and difficulty in accessing digital maps, an agreement was made with a local quasi governmental organization dedicated to geographical information application in public administrations.

#### 3.4.2. Material Resources

Initial resources to start the project in Gujarat came from the coordinating university and PHIS. The aim of making local implementations sustained by local administrations was reinforced by the adoption of FOSS licenses, which allowed addressing funding to local salaries. This aspect has always been welcomed by public administrations, as it allows keeping control on software customization, personnel training and system facilitators (in charge of making terminals to work properly).

It has to be noted the always slow provision of funds, both from the state and from the coordinating university, the latter because of restrictions in transferring money to India. Another problem was personnel high turnover at all levels. The health department's IT consultant who contacted PHIS left after a few months the project started. A few weeks before the contract to scale up the system statewide was to be discussed, the contact within the health department left the position. All the months during the project have been characterized by a concern regarding the displacement of the key PHIS contacts before a memorandum of understanding was signed<sup>8</sup>. The development team always risks having people leaving to the higher-paid and rapidly growing Indian IT private sector.

#### 3.4.3. Symbolic Elements

Symbolic elements of legitimation of the project in Gujarat did not prove to be crucial. The project was accepted at state level, but lack of capacity at PHC level, lack of infrastructure and 'champions' leaving

their posts lead to the project being abandoned. Indeed, at two stages they seemed to be important, but they did not have the expected consequences on the long term. After the evaluation of the first pilot, PHIS team was provided with office space within the health ministry. When for example the "dashboard" indicators needed to be negotiated, the commissioner officially appointed representatives from the ministry side, even if an informal provision of mathematical formulas would have been enough.

### 3.5. Kerala

Kerala is a small state at the south-western coast of India with a population of about 32 million people. Although it has a high density of population, it is described as a model for a developing country because of high achievements within health and family welfare. The State Department of Health and Family Welfare (DH&FW) is responsible for the Health and Family Welfare programme in the state. Services are provided by 143 hospitals, 105 community health centres and 943 primary health centres. In the administrative structure of the Kerala DH&FW, organization of health facilities is coordinated by the district and state levels, Directorate of Health Services (DHS), Directorate of Medical Education (DME) and Directorate of ESI Medical Services (under the Labour Department). At the district level District Medical Officer of Health (DMO) is in charge of all the H&FW activities. Most of the public hospitals are controlled by the DHS. Five of them are attached to medical education; they are the medical colleges, tertiary health care level. These hospitals are accountable to the Directorate of Medical Education (DME) and not to the DMO. Both these directorates fall under the central ministry of health but have little to do with each other when it comes to coordination or information sharing. Since 2005 the National Rural Health Mission (NRHM) has been established as a national initiative to improve the availability of and access to quality health care by people residing in rural areas and also for coordination across programs and sectors.

#### 3.5.1 Social Activities

Since 2004, PHIS has been working in Kerala within primary health care in collaboration with the government. Through meetings with central stakeholders in the health administration hierarchy, information requirements and the existing data collection routines have been analyzed. Similar to other sites where PHIS has been involved, there were inconsistencies of report formats collected from a variety of health facilities that created problems in mapping the information flow. HIS was adapted to the Kerala PHC needs and it is currently running in one district (Trivandrum) in Kerala, now covering all 19 Community Health Centres (CHC) and 80 Primary Health Centres (PHC) in the district. The application has also been translated into Malayalam, the local language. There has been an ongoing training and support of CHC and PHC staff, and currently 13 facilitators are hired by the PHIS to follow-up the facilities.

Hospitals were also to be included in the aggregated data collection, which was a novelty for PHIS implementation in India. The hospitals have different formats used to organize information

<sup>8</sup> These position displacements often occur due to anticorruption rules in Indian public administration that impose frequent and sudden displacements of high officers.

flows within hospitals, and to report to the DHS/DMO/DME. There is fragmentation of information flow also across hospitals, as information circulated is limited to patients' referrals. ICD (International Classification of Diseases) is required to be used by international organizations in order to facilitate monitoring and evaluation. The process of adoption in the hospitals took some time, because physicians and nurses did not change diseases name while carrying on their health delivery activities. Nevertheless, ICD got stabilized at the end of the hospital information flows, i.e. in the Medical Registers Office, where diseases in "case sheets" are indexed and categorized before reporting and storage.

Confidentiality revealed to be a crucial obstacle for information flow across HIV facilities. Information exchange within facilities is limited to symptoms of a case (that is linked to a personal number, not to a name). This is further complicated by the fact that patients do not disclose correct details about themselves. It is not unusual for them to register at a center with fake names and addresses (20% of registered patients' names are fake).

### 3.5.2. *Material resources*

The Kerala project has been active in the state for two years before the public administration accepted to fund it directly. Before and after this decision, resources were provided by projects coordinated by the Norwegian university, and by contracts with other Indian states. When an agreement was reached with the FH&WD, part of these resources was expected to be diverted to states which supported Kerala team previously. This was troublesome. The next phase of the project is funded by the National Rural Health Mission.

### 3.5.3. *Symbolic Elements*

The communist Indian state of Kerala is the first to explicitly provide a place for FOSS in its official policy. Official documents set out a strong vision, for example: "The Government realizes that Free Software presents a unique opportunity in building a truly egalitarian knowledge society". The government will take all efforts to develop free software and free knowledge and shall encourage and mandate the appropriate use of free software in all ICT initiatives (Government of Kerala: 2007).

### 3.5.4. *Points from the Indian Cases*

In spite of being from the same country, the last two cases differ considerably for the interaction with the quite different institutional settings. In Gujarat, a strong legitimization at the district level has been pursued. The long time it took mismatched with the hurry the health commissioner put on managerial information to be available for decision-making. This situation highlighted the obstacle in moving the flow of health information from bureaucratic to managerial lines. This was expressed emphatically by the health commissioner who criticized the activities for focusing primarily on the routine reports, which were of limited value to his management needs: "I don't want a system that merely automated the existing inefficiencies" he said, then "we need a 2-3 pages report, to take action on." Insufficient coverage of the top organizational part allowed another player to substitute PHIS (which was some months later

called back).

The alignment in Kerala took place slowly but linearly at the top level, also because of convergence on symbolic aspects, given the Kerala strong orientation toward FOSS.

## 3.6 A Constituting Ground of Activities

### 3.6.1. *Social activities*

In 2006, a UN organization provided funding to the South African team to implement data exchange between HIS version 1 and their system for country level management of health indicators. They were developing a standard XML exchange format for aggregate indicators in collaboration with a few UN partners. A handful of UN systems could already handle this format (Safarnejad: 2006), and it was hoped it could serve as a lightweight and agile alternative to a more complex standard created by the international financial sector<sup>9</sup>.

They were also interested to know more about how PHIS was working in other parts of the world. Several meetings were held to explore possibilities for strategic and regular collaborations, and funds were provided to make version 2.0 capable of handling their XML format. System integration and joint implementations were discussed for several countries, with work already underway in Botswana. Specific discussions focused on the area of Anti-Retroviral Therapy, with a PHIS effort underway in Ethiopia to build a system (separate from the HIS) for clinics there. This system, though, targeted the same space as another major open source patient record system (which we here will call Open Patient Record, OPR) initiated by two US health research institutes, who were also working closely with parts of the UN. It was therefore gradually decided that a more robust strategy would be to go for a joint implementation, with the OPR serving operational needs at the clinics and sending aggregated data to the HIS system for analysis and reporting further to the country and international level management systems. Collaboration with OPR seemed especially attractive because of the use of basically identical technological platform and similarity in FOSS philosophy and approach.

However, as the first steps of a joint implementation PHIS-UNAids were started in 2007, it was realized that the ongoing development directions of the two indicator systems meant an increasing overlap between the two systems, and the country management system was based on proprietary (as opposed to open source) technologies. Therefore, the direct collaboration withered. But through the process, PHIS was thoroughly introduced to many related activities under the UN umbrella. For example, the HIS version one was introduced for data collection for tuberculosis replacing an internal effort at creating a comparable system.

In early 2008, initial collaboration on implementation of these systems in combination was launched in Sierra Leone and in Zambia, where HIS version 1 was already being piloted, and work was carried out to make OPR and HIS able to both export and import data using the lightweight XML format<sup>10</sup>.

<sup>9</sup> SDMX Statistical Data and Metadata eXchange, <http://www.sdmx.org/>

<sup>10</sup> Material resources have not proved to be determinant at this stage.



### 3.6.2. Symbolic elements

In connection with the World Summit on the Information Society in Tunis in late 2005, an initiative was launched to “provide a technology platform that supports the collection of sub national health data and statistics for analysis, dissemination and use to facilitate decision making in health, and strengthen capacity of African countries to use information in decision making.”<sup>11</sup> Two PHIS coordinators attended the launch discussions.

In December 2007, several of the UN groups mentioned above, as well as representatives of many African ministries of health, and information systems projects, including PHIS and OPR network took part in a conference on standards which was convened in Kenya, where various information systems were presented along with case studies from a range of African countries, as well as Brazil. The need for collaboration and sharing of best practices and standards was repeatedly underscored, as a precondition for successful implementation information systems for public health.

In the spring of 2008, a reorganization took place within the UN system which emphasized closer collaboration between several of the sections that PHIS had been involved with, signaling an emphasis on uniting efforts on statistics and informatics under a common leadership.

Similarly, close collaboration was initiated in late 2007 with a group within the UN system focusing on GIS. In striking parallel with the PHIS trajectory, they had developed a desktop system in the 1990s, and needed to make the transition to the world of web applications. Furthermore, they saw the potential of enrolling a wider FOSS community in the development and implementation of the system, with the UN experts in more visionary, consultative and coordinating roles. Again, the technological platform was largely similar to the choice for HIS version 2, which facilitated the collaboration on a practical level.

### 3.6.3. Points from the case

For PHIS coordinators, the variously linked and continuously evolving collaborations with the international organizations were seen as key to achieving the scale needed both to have serious impacts towards the vision, and for doing research on large scale information systems and infrastructures.

The emphasis on a brand name, future oriented architecture using cutting edge tools afforded collaborations with technical staff in global organisations as well as with related open source projects. However, this shifted the emphasis away from health and towards technology, and in the process, paradoxically making it *harder* for the implementers who had some, but limited technical training to take part, though the aim was explicitly to enroll participants all over the network in distributed development.

<sup>11</sup> <http://www.who.int/kms/initiatives/ahi/en/index.html>

<sup>12</sup> A technical solution of the database management system that allows the breakdown of a “data element” along flexibly defined dimensions, increasing flexibility, ease of use, and reducing duplications.

## 4. Discussion

Our research questions were: “How does PHIS conceptualize its fields of action?” and “How does PHIS interplay with different institutional settings?”

Each of these questions brings us to a specific contribution, which we summarize here: 1) in spite of a common approach, the IT agency is not determinant in shaping the IT artefacts, at least in the contexts and time frames under consideration. Institutional settings, intended as sets of regulatory constraints, heavily influence the enactable functions of health information systems and their evolution. As the structure of an organizational field has to be defined through empirical work, we can now say that 2) the fragmented organizational field of “health information systems in developing countries” makes isomorphic tendencies weak. However, we want to emphasize the limited generalizability of our conclusions due to the time restrictions of the study, compared to the long time frame of such health information systems’ evolutions.

As described in § 3.1, after several years of activities, PHIS action consolidated into the below common trajectory for all implementations:

- 1) Initial contacts with local health care authorities
- 2) Situational analysis and assessment of health information systems
- 3) Customization of HIS software
- 4) Pilot implementations
- 5) Training
- 6) Scaling up of HIS and attempted institutionalization

The visions and expectations of PHIS as an institutional entrepreneur crystallized in this model of implementation, which describes its posture in respect to the variety of contexts where it is active. More specifically, the principles of a bottom-up roll-out of HIS (introduced in PHIS global, paragraph 3.1.2 on symbolic elements), can be retrieved in the emphasis on situational analysis, customization of software to local needs, and establishment of pilots. The links between principles and strategy are used to get (symbolic) acceptance, mobilize resources, and orient (collective) actions.

We do not want to leave technology aside as if it were solely a tool for organized action. The HIS has specific characteristics which allow a set of solutions to be provided to health care systems. Therefore, software features contribute in shaping what PHIS proposes, does and how. Precise examples can support our standpoint: “multidimensional data elements”<sup>12</sup> allow handling large datasets in a more consistent way. This function came from requirements from different countries, aimed at reducing fragmentation and duplication of data. Once this got inscribed in the software, it reinforced the PHIS emphasis on such problems of health care systems. Another example: HIS embedded various functions of automatic validation of data entered (e.g. not allowing data out of a certain range). This feature has been proposed as a solution for the low quality of health data collected, and allowed more emphasis on this issue in the negotiations with a variety of stakeholders.

Those topics are often highlighted in situational analysis reports, which provide the basis for further HIS implementations.

The encounter of a global network with local institutional settings is also evident by looking at the multiple accountabilities (Suchman: 2002) to which actors are held. Software developers in Gujarat were expected to be accountable to PHIS (which shares software on the global network), whereas the health program manager (whom the programmer was working for) was responsible for her/his specific health program, with other priorities. Graduate students, for example from Ethiopia, received grants from different donors to participate in the action-research project. Such affiliation with universities was thought to be an important aspect for sustainability of the project in two senses: a) such organizations can play a crucial role in capacity building at different levels of the project, and b) counting on universities in the project partnership provides more legitimation to ongoing and future activities. On the other hand, such arrangements have originated tensions between priorities of action, and priorities of research.

Differently from the South African experience of establishing the Essential Dataset, the bottom-up approach was not successful in the Ethiopian context. Regarding the definition of a data set for health information from different levels of the health facilities of the regions through the Regional Health Bureaus (described in paragraph 3.2.1), they did not manage to define the data elements for their region. This event exemplifies how a bottom-up model, emerged in the post-apartheid South Africa may fail in a highly hierarchical environment, where entry-points and accountabilities are toward the top of public administrations. In spite of huge efforts in local capacity building, none of the cases showed a crucial role played by the low organizational levels of public health care systems. In very different ways, all cases saw a primacy of the top organizational level in affecting the trajectory of the IT artefact. Because of the weak accountability of such organizations to their target population with respect to the political power, the origin of legitimation and uncertainty came from the higher echelons of the health hierarchy. To different extent, this mismatched both with PHIS orientation and the need to keep public health care systems accountable to changing needs of the target population.

Another relevant divergence, evident in the Gujarat case (paragraph 3.3), is between the flow of bureaucratic information (i.e. vertical health programs) and managerial information. The institutional constraints to move from bureaucratic to managerial information were clear when it was necessary to calculate managerial indicators, which required data from different sources, departments, and programs, which usually did not share information, not even when officially requested. Also from the Gujarat case, it is notable a mismatch between participatory design approach and local functioning of hierarchies. This led to a stop of the activities, a redefinition of the agency and a restart.

Different sources of legitimacy lead us to refer to a crucial distinction between legitimation in

the local context or in the organizational field. Analytically, this is one of the main differences between Old and New Institutionalism (Powell and DiMaggio: 1991). New Institutionalism focuses on the symbolic role of formal structures, and emphasizes how organizations are embedded into their organizational field, rather than in their local context. Consequently, the institutionalization process is seen within the field, rather than in the specific context. Without a defined field, organizing visions (Currie: 2004), fashions (Currie: 2004, Czarniawska:1997, 2005) are not effective forces affecting organized action. It has to be kept in mind that legitimation within or outside the organizational field does not necessarily coincide with different organizational levels (local, national or international). In spite of significant differences, the cases show a clear tendency of legitimation into the local context, rather than in the field.

This introduces the second research question, which is about the interplay of the IT agency with different local contexts. It is not uncommon that IT projects pay little attention to their contexts of reference, whereas context is what proved to be determinant for our cases. Each of them displayed some tension between local context and organizational field legitimation, in terms of software development (fragmentation vs. standardization), resources allocation and orientation of activities. For instance, the information system to support HIV facilities in Kerala is relevant here, because the strict enforcement of confidentiality within HIV care system did not allow health personnel to share the identities of people (and not even to check them). Thus, tracking patient trajectories was not a suitable strategy for customization and implementation of a HIV information system. This exemplifies how the actual use of an information system is also tied to the deinstitutionalization of local regulatory constraints.<sup>13</sup>

More on the macro level, we can refer to the Botswana case (§ 3.2), where the British model of a democratic parliament combined with a local semi-hereditary tradition (called House of Chiefs) have resulted in a gap between the national and local levels. This context, where PHIS is active mainly at the state level, is a quite decentralized political system. The split has led to the creation of a Ministry of Local Government, which is not necessarily aligned with the Ministry of Health. Besides, the fragmentation of the Botswana health sector has other dimensions: four ministries and the military are involved in producing, processing, collecting, and analyzing health data. This explains why a range of parallel systems can be found for various health programs, which organize their own information.

We assume that development is the sought result of a goal-oriented organizational change, as institution-building (DEVS: 1990 and United Nations: 1982) suggests. In spite of that, it is not unusual that health information systems fail because their design and implementation are based on explicit organizational structures and formal requirements, which are missing in considering mismatching rationalities (Heeks: 1999) and the actual institutional constraints (Piotti et al.: 2006). New Institutional theory places central

<sup>13</sup> Although it is not the main point of this article, it has to be noted that through such processes, both public administrations and the PHIS network can learn. Furthermore, the product of this learning can be found in organizational changes and inscribed in software.

importance on the organizational field, and on the isomorphic tendencies of the organizations within the same field (Powell and DiMaggio: 1991). Across developing countries, we could not identify an established organizational field of health information systems, nor a trend towards uniformity among such projects. We can build on the idea that information flows through public health organizations tend to depend on multiple rationalities (Avgerou: 2000): local regulatory constraints, which heavily shape PHIS-related social activities, material resources and symbolic elements are beginning to interplay with an organizational field of health information systems. Therefore, on the one hand, information availability and use depend on particular power and advantage, also embedded into local explicit and tacit constraints to action (hierarchies, accountabilities to procedures rather than to results, particular interests). This implies that information hardly spreads beyond predefined channels, missing the chance for increasing its value by being recombined and analyzed. On the other hand, both local and global players are 'invited' to conceive themselves as actors of the same field.

On different scales and strategies, we presented global development organizations and networks such as PHIS as facilitators of such process. Indeed, to some extent, an organizational field can possibly be said to be in the process of being constituted by the coordinating efforts of several international organizations, through initiatives like the cataloging, linking, and promotion of available systems, increasing emphasis on openly available web based tools and regional workshops on standardization, and indirectly by PHIS, which lobbies for health information systems in a number of countries.

Accepting the assumption that organizational fields and isomorphism are related, our recommendation would be the support to the emergence and legitimation of an organizational field on health information systems across developing countries. It is possibly a way to attract a variety of actors into the field, all of them necessarily engaged in contextualizing their solutions, both in local settings and the field as a whole. This means that the way to broad implementations of IT for health remains not so much in legitimizing a best practice to be replicated, because its success can heavily depend on casual match with local context. Creating common classification systems and measures (Déjean et al.: 2004) is certainly a way to establish key regulative constraints that organizations and initiatives can incorporate in order to gain legitimacy and stability (Meyer and Rowan: 1977). The potential role of an organizational field is clearly presented by

*"the resultant path of institutional change is shaped by (1) the lock-in that comes from the symbiotic relationship between institutions and organizations that have evolved as a consequence of the incentive structure provided by those institutions and (2) the feedback process by which human beings perceive and react to changes in the opportunity set"* (North: 1990).<sup>14</sup>

We started our effort of contextualizing the IT artefact by referring to 'development' and its origin in the idea of 'progress'. After presentation and discussion of the cases, for the field of health information systems, we can suggest that development efforts need a meso-level of legitimation for organized action, in order to find a balance between local fragmentations and top-down diffusionist approaches. This set of formal and tacit rules implies a rethinking of the hegemonic idea that problems are "out there", rather than the product of a specific world view. This text proposes some starting points for these travels.

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<sup>14</sup> A more critical use of Neoinstitutionalism in health information system is the article by Noir and Walsham (2007), who underline the paradox of control and legitimation within the field, also independently from expected results. We cannot engage in a direct conversation with them for two main reasons: they have identified an organizational field of reference, we did not find it; secondly, their research is more on the micro empirical level.

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