Scalability as Institutionalization - Practicing District Health Information System in an Indian State Health Organization

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ABSTRACT. This paper is based on an analysis and of the introduction and scaling processes of a health management information system in the public health care system of an Indian state. The system is developed and implemented by an international action-research network in close collaboration with the local health department. The purpose of the system is to improve health information circulation and use within the health system by establishing action-nets to get institutionalized into organizational practices. Data is being collected by directly participating in this project within an action research framework. This ongoing initiative is presented by introducing the two main organizations involved (the health services and HISP, the implementing organization), and then focusing on the way they are interweaving part of their activities around the health management information system. The conclusive part discusses how this process is relevant for learning and the scaling up of these kinds of systems.

Keywords: information system scaling, institutionalization, practices, action-net, health organization, organizational learning.

Like composers, we cannot write music for which there is no instrument Howard Becker

1. Introduction

The initial quotation makes metaphorically clear the nonsense of information system design without considering the contexts of implementation. Thus, the approach of this action-research is rooted into the Mahatmapradesh state¹ (India) health system, where an information system is being developed and implemented into the local organizational routines.

We assume that development is the sought result of a goal-oriented organizational change, as institution-building suggests. Information and Communication Technologies (ICT) hold the promise for rural areas development as they allow distant coordination, and make remote organizing more viable. In spite of that, *it is not unusual that health information systems* (*HIS*) *fail because their design and implementation are based on explicit organizational structures and formal requirements*. In order to avoid such reductionism, several issues have to be considered, such as: software and electronic network functionality, institutions, learning, practices, labor and support – these comprise what we term as an action-net (complete definition in the theoretical section). These elements will be considered in the presented case in order to describe two action-nets produced by an information system's implementation, and conclude with some ideas to take stock of ICT in 'development' contexts, specifically in the sector of public health. Theoretically, the issue of scalability of a health information system will be examined in institutional terms.

The plot of this submission begins with presenting a large bureaucratic organization where the HIS is being implemented. On the other side, the trajectory of the non-governmental organization "Health Information System Programme" (HISP India) responsible for the HIS being implemented, is a premise to introduce the intersection of those two organizations and the implications that it has for scaling up the HIS and the associated processes of institutionalization.

This paper is organized as follows: after presenting the research approach (§ 2), the Mahatmapradesh health care system is described (§ 3) as the context for the HISP India health information system (§ 4). After that, the theoretical framework is delineated (§ 5); this helps to bring in a theoretically informed account about two required (sub-) information systems (§ 6). Implications for scaling and institutionalization are discussed in the conclusions (§§ 7, and 8).

2. Situating Research and Authors

In an action-research approach which is characterized by a continuous process of adaptation of theory and practice, it is relevant to make explicit some reflexive issues that inform this initiative. They will be presented starting from the research question, then presenting what methods are chosen to look for appropriate answers, and then briefly introducing the role of the authors in the project.

¹ All names except of HISP India are disguised.

2.1. Research Questions

We propose to start by looking at the action-net that the information system attracts and supports. *This perspective is rooted into the idea that informal organizing is as important to understand the design, implementation and organizational processes as the formal and official structures.* Such a standpoint presents a point of departure from the mainstream approach to information systems and organizations which tend to be conceived as linear implementations of rational designs, and requires special attention for the cycle "theory - action - modified theory - modified action".

The general question about how 'development' can take place and be backed through information systems is proposed in this IFIP 9.4 conference by the following question: "What new organizational forms are possible?" On this line, we specify that question by asking:

"How can action-net -related to an information system- be constructed and institutionalized?"

More specifically, it can be broken down into sub-questions:

- What is the action-net 'provoked' by the District Health Information System (DHIS 2.0, the specific HIS in question) as being implemented by HISP India in Mahatmapradesh?
- Who and what is this action-net constituted of?
- What boundaries exist around and within the practices?

Last but not least, this broad question will also be kept in mind: "What is beyond the HIS but relevant to understand the system itself?"

2.2. Methods and Approach

Answers to these questions are affected by authors' roles and viewpoints, which need to be made explicit. One of the authors is the founder of HISP India, and initiated the Mahatmapradesh project. The other is carrying on a participant observation within this project. Although this is not a grounded research, it is our purpose to keep it open-ended by remaining sensitive to what the project and research processes suggest. This does not exclude an intention to develop and clarify a normative stance, by discussing and pursuing what "should be". Before introducing data and presenting our answers to the previous research questions, it is necessary to explain the main reasons that justify our theoretical and methodological choices. That is relevant to clarify how the cycle of mutual affection theory-action is understood and kept coherent or, in other words, how learning takes place. The data collection lines and roles correspond with these two research inquiries:

- How the Mahatmapradesh health care organization and HISP India are interweaving their activities by working around a HIS; and,
- How feedback loops within the health care system can be developed by analyzing the data provided by the system to improve planning and take organized action.

This study is based on qualitative data collection, and interpretative approach within an action research framework. Quantitative data are used as empirical material as far as they affect the field of study.

The HISP action-research in Mahatmapradesh has started in February 2006, and has been enriched by individual and group level semi-structured interviews. A focus group around the

'dashboard' (a collection of critical indicators for the health management) has recently been organized to coordinate its definition and implementation. Shadowing is another method used to follow health personnel, officers, software developers. Another important component of the participant observation concerns the online activity of the HISP group (email, mailing list, chatlines, and phone calls), which is very important for the coordination, and understanding of activity. A number of government records and reports were also analyzed to further gain an understanding both of the Mahatmapradesh health organization and its ongoing processes of its partial intersecting with HISP India.

3. Mahatmapradesh Health Organization: The Context of Implementation

Mahatmapradesh state population was estimated at about 50 million in the 2001 census. That state public health care system is constituted of 1070 Primary Health Centers (PHCs), 253 Community Health Centers (CHC), usually situated at the taluka (sub-district) headquarters. The Block Health Office (BHO) is a concept particular to Mahatmapradesh state to enable the coordination of various administration tasks at the sub-district level, and between the levels of the district and community, including activities around the HIS. In the HISP project, the computers are placed at the BHO, and all the PHCs and CHCs included in the Block came to the BHO for their information processing activities (including data entry and report generation).

The Mahatmapradesh health activity reporting system follows the organizational structure: each level aggregates data from the lower one, adds new data and produces its own reports as per predefined national formats. The formal organizational structure is represented by the scheme below.



Figure 1. Information flows within the health care system. The table on the right shows the main existing routine reports [forms] that have been incorporated into the DHIS.

Figure 1 represents the bureaucratic domain of information flow within the health department. HISP started from the automating these flows, and is increasingly working on the managerial use of information (whose flow partially mismatched with that), as it will be clarified through the case study.

4. HISP India's Trajectory

The Health Information System Project (HISP) is a global network on HIS design, development and implementation established around 1994 by the Department of Informatics, University of Oslo, Norway. This global network is working in various countries including South Africa, Mozambique, Botswana, Malawi, Ethiopia, Tanzania (and Zanzibar), India, and Vietnam. HISP aims at strengthening HIS to support public health management, especially for the district and sub-district levels, by enabling health personnel to use their information and to improve the coverage and quality of health services delivered. HISP is based on action-research, and seeks to create linkages between various activities around health conditions, their improvement and research.

The DHIS 2.0 version of the software, based on a free and open source framework, is currently being implemented in Mahatmapradesh. The project implementation started in March 2006 with a pilot in Parsinagar, a district in the southern part of the state. In July, a positive evaluation (by the state authorities and a prestigious national management institution) opened the door for the "scaling up" of the system. In mid August, heavy monsoon rains proved disastrous for the region, with hundreds of deaths and enormous material damages. This delayed the system implementation because the health care administration was dealing with other priorities. Anyway, at the end of that month, the Health Commissioner assigned four more districts to HISP for implementation. These districts were in the northwestern part of the state, not directly affected by the floods. Through 2007, all the 25 districts in Mahatmapradesh are expected to use the DHIS 2 within the framework of HISP.

4.1. Parsinagar Implementation

The pilot project in Parsinagar district needs to be situated within the Mahatmapradesh public health organization. The focus is on the BHO level for three main reasons:

- Very limited data collection takes place upwards (at the district);
- It is between the health care system and district/state administration;
- Health staff routinely comes to the BHO for various administrative tasks like salary collection.

The following are some of the characterizing aspects of the information system:

- It is mainly focused on reporting both routine and for analysis (e.g. indicators),
- It is being implemented at state, district, and BHO's levels, and in the future can be extended to the PHCs (below the BHO level) if computers and related infrastructure are made available there,
- It is integrated with the paper based information system, and -through that- to other public administration procedures (such as resource allocation although more in theory than practice).

The Parsinagar implementation has established the premises for further institutionalization of the system, both through the expansion to new districts and also by incorporating additional system requirements. Two examples are presented in this case, one concerning a Graphic Analyzer (a 'dashboard' of managerial indicators) and the second of a Geographical Information System (GIS).

5. Theoretical Frame: Scalability as Institutionalization

This section introduces concepts to look at what is taking place within the Mahatmapradesh health system, specifically related to the HISP initiative. More specifically, the scaling up of the DHIS as institutionalization will be seen as a process of both formal and tacit negotiations taking place between the involved actors, or -in other words- as a process of integration of various formal and informal practices. The presentation of the case starts with the description of the Parsinagar pilot, and continues with the description and analysis of the institutionalization processes that is taking place at state health system headquarters, where HISP has been assigned office space, which has both material and symbolic implications. The "dashboard" and the GIS are described as they help to understand the processes of intersection between the two organizations, and its implications for institutionalization. These two systems are looked at as "boundary objects", i.e. as artifacts on the points of encounter of different groups, which can establish relations through those kinds of objects. Boundary objects have different senses for the different social worlds they intersect.

As the design-implementation process is not taking place linearly, nor within a single and stable organizational structure, we need to rely on theoretical concepts which are able to account for the empirical context. The idea of the action-net looks at organization as the result of different and interwoven individual and group actions. They do not axiomatically take place within one formal organization, and can comprise a wide variety of recursive and temporary actions by very different actors. So, the action net is composed by the actions needed to perform organized action.

Lindberg and Czarniawska [2006] propose clear distinctions between action net, organization fields, social networks, and actor-networks (all concepts widely used in information systems studies). The organization field, originated from the New Institutionalism, denotes the frame of reference for organizations engaged in a specific activity, their interactions constituting a recognized area of activity. Czarniawska notes that the concept may fail in capturing the interactions actually occurring (organizations in the same field, like universities in the higher education field, may have no direct contact among them, and be characterized by relationship with other entities).

A social network is based on the connections between actors, rather than between actions: "in an action net perspective, actors are exchangeable, whereas in a network perspective it is actions that can be so described. The Mafia is a network: when one type of action fails to be profitable, Mafia members take some other action—but the same actors are involved." [idem, p. 3]

As an action-net, the actor-network approach assumes that actions constitute actors. In Czarniawska's view, the difference between these two concepts is about the time of the study: "ANT studies begin when translations and connections between actions in an action net have already begun to stabilize." [idem, p. 3] This makes the action-net concept particularly relevant for this case, which is studied during its realization.

Scalability is usually referred to a technical system's characteristic of being extendable in functions, or its ability to do more work, and to cover larger areas. The meaning has also an economical sense: a system is scalable when new purchasers bring incremental advantages to the system itself or, from the other perspective, when higher production reduces the cost per unit, increasing the marginal profit. Scaling up an information system has been described as a strategy to achieve sustainability and more relevance [Braa, Monteiro and Sahay: 2004]. In this paper, the term scaling is used from an institutional perspective: scalability will be seen as the ability of the information system to get recognized, accepted and used within normal

courses of action. Thus, it would get subsequently scaled through institutions. This means both that the system aims at getting embedded into existing practices and enacting new routines, which are expected to become normal in local construction of organized action (as described later).

The concept of institution needs to be introduced: "all human societies are characterized by more or less complex and overlapping net-works of regular social interactions and social practices. Whether economic, political or cultural, such repeated interactions require agreed and predictable rules about ways of doing things. Such sets of rules constitute institutions" [Leftwich: 2006, p. 1], which can be both formal and informal. Formal ones "are normally established and constituted by binding laws, regulations and legal orders which prescribe what may or may not be done. Informal institutions, on the other hand, are constituted by conventions, norms, values and accepted ways of doing things, whether economic, political or social." [Ibidem] This definition is in line with the New Institutionalist view [Powell and DiMaggio: 1991]. Through this paper, the micro-level of institutions is seen in form of practices [Miscione: 2007], and will be linked with the concept of action-net through the next paragraph.

5.1. Action-Nets and Institutions

This submission approaches scalability in terms of institutionalization. Therefore, it will consider the consolidation of action-nets in institutional practices. Through the paper, the accepted working definition of practice is: "*I define a practice as a mode, relatively stable in time and socially recognized, of ordering heterogeneous items into a coherent set*." [Gherardi: 2006, p. 34]. This definition:

- helps in fully including the artifact into the organization description,
- moves action-net concept towards institutions (being more stable and recognized courses of action),
- avoids a taken-for-granted rationalistic standpoint,
- goes beyond formal organizational belonging of actors, as organizing actions and belonging to organizations are decreasingly congruent,
- situates practices between fluid action-nets and institutions.

To sum up the use of the concepts proposed:

- *action-net* is a set of actions performed by a variety of actors to perform a collective action. If it is socially recognized and stable, it can be labeled as 'practice',
- *practice* is a socially consolidated mode of ordering heterogeneous items,
- *institution* is a social model embedded into normal patterns of action.

The use of these concepts aims at rethinking the way we look at socio-technical processes, going around some limitations involved in the traditional focus on places, people, or issues. This is important when we deal with (community of) practices [Wenger: 2003] engaging rather diverse actors, such as Mahatmapradesh health care administration and facilities, Oslo University Informatics department, computer programmers from different continents, local system facilitators.

The most relevant practices in which HISP Mahatmapradesh is currently involved are:

- Software development (mainly constituted by HISP developers and coordinators, state health programme managers, University of Oslo developers, bureaucratic procedures shaping for example who is responsible for providing requirements);
- System implementation (system facilitators, training processes, BHOs, hardware vendors, connectivity providers, DHIS users, reporting requirements and routines);

- Health care activities reporting (auxiliary nurses, system facilitators, supervisors, officers who consolidate reports, paper-based information system),
- Health activity planning and policy-making (health programme managers, Health Commissioner, national directives, district officers, district programme coordinators); and,
- Cultivating a culture of information use (HISP public health specialists, health officers and managers, data validation tools embedded into the DHIS, training courses, awareness raising of data reliability importance, practical links between information and health delivery).

Each practice involves several actors that perform the various actions required under varying constraints and support mechanisms. An action-net denotes actual connections among actions, the DHIS serves as a boundary object within and between those actions, and their performers. Star and Griesemer [1989] state that boundary objects are in tension between different viewpoints and the necessity of collaboration around them. Boundary objects do not require consensus on the intersections of different social worlds, cooperation around/through boundary objects require mutual understanding on the boundary, but not necessarily a common rationality. Mutual understanding and sense-making is considered on the collective rather than individual level (Puri [2007] proposes a relevant example). This characteristic of boundary object is central in making the concept suitable to this case, which comprises such a variety of dispersed actors.

To link back scalability and institutionalization, we look at (and work within) the action-nets which are being constituted into the health care system. This acceptance and legitimation into local practices are the way for getting the system institutionalized and therefore scaling it up.

6. The 'Dashboard' and GIS, Knotting Organizations

In this section, the 'dashboard' and GIS's developments are presented as examples of two different processes through which actors establish action-nets by engaging in activities around a common boundary object with the aim of institutionalization.

6.1. Reporting: the Premise for the 'Dashboard'

Development and customization of the electronic routine reporting system within organizational levels of the health care system had been carried out at Parsinagar following the principles of participatory design. This has been the way to 'tune' the system to the local requirements and needs, and to keep design and implementation closely interwoven. This is producing an *ongoing institutionalization process made up not only of formal agreements, but of relations of interchange and mutual involvement, that we can call action-nets*. The positive evaluation of the Parsinagar project (at least partially) legitimized HISP Mahatmapradesh within the state health care system and set the basis for its scaling up to 4 further districts.

More specifically, the state health care organization -relying on the existing organizational routines- invited HISP to develop the HMIS. The existing formally required routine reports provided the point of departure for further requirements. The need to establish connectivity of health reporting between the lowest levels and the state was seen as a key ingredient for making the health system more effective. In spite of this apparent common agenda, and a general agreement about means (implementing the HMIS at different levels, from state to blocks), divergent accountabilities can be noted, both with respect to the responsibility of the persons in charge, and shared sense of what are the routine activities. For example, a software developer's activities are expected to be accountable to HISP, while the health program manager -whom the programmer is temporary working for- is responsible for her/his specific health program, in addition to the overall state health department. This may create

divergences, for example, in synchronizing the priorities of the developers with the pace required for the implementation. Similar divergences are normal when different organizations engage in the same action-net (merging part of their activities). These interactions need to be managed to avoid disruptive discrepancies, and to build new stable practices. It is not secondary that this action-net's consolidation can potentially be made easier with HISP being assigned an office space within the health administration building in the state capital: as jointly engaging in everyday activities can be of great help in developing mutual understanding, coordination, and alignment.

6.2. Action-Net for the "Dashboard"

The need for a 'dashboard' (or a "Graphic Analyzer" for visualizing managerial indicators) was proposed by the State Health Commissioner to routinely gain an overview of the state health situation while focusing on a limited set of relevant indicators. Developing such a focus is not easy in an organization where the history is one of collecting a large number of data-elements with little emphasis on how they relate to the computation of indicators, their use to understand health situation, and their use for activity planning.

Also, the 'dashboard' signifies the need for relating diverse data sources (bureaucratic forms, vertical surveys, etc) and presenting it to the managers to be used accordingly to action needs of different organizational levels. *Such action-net required performing data linking, planning and consequent activity, which are not part of existing organizational practices,* and cannot be reduced to the formal role of specific officers. It can be noted from HISP experiences in other Indian states that this poor relation between data-elements, indicators, and planning is a general problem, and in this sense, Mahatmapradesh can be seen to be more progressive than other states, as it is currently engaging in the discussion around indicators, even though they are not currently used.

The need for the dashboard was expressed emphatically by the State Health Commissioner who criticized HISP for focusing primarily on the routine reports with limited value to his management needs. He did not want a system that merely automated the existing inefficiencies. The slow progress on this front (indicators) in creating the dashboard from both the state health officers and HISP team was reprimanded by the Commissioner who declared "we need a 2-3 pages report, to take action on." This direct demand from the Commissioner and his dissatisfaction with the state of progress helped to galvanize some action from both sides (the Health department and HISP). The Commissioner designated one of his senior officers to oversee the dashboard implementation process, and HISP from their side deployed one senior medical doctor to interact with the Health department. This led to a process of negotiations and meetings, starting off with defining the indicators starting from the Reproductive Child Health program. As a result of these negotiations, three successive versions of the indicators were produced, and the final list has been approved by the Commissioner. These indicators have been inscribed into the DHIS 2, which is now able to provide the required reports on a routine basis to the state authorities, and hopefully will lead to the initiation of actions concerning the review and use of these indicators to improve health care service delivery. Similar processes of indicators definition and their implementation are also planned for other health programs and also with other levels of the health administration (District and BHO).

While earlier attempts to create similar indicator lists were ongoing in the organization, they did not fructify into something concrete and useful for the Commissioner because of the separation between the managerial and the bureaucratic domains. The actual challenge is how this action-net can be institutionalized into the organizational practices. For example: the

calculation of managerial indicators will require data from different sources and departments (such as those conducting health surveys and the routine systems), which thus creates the potential of horizontal information sharing, very useful in an organization in which divisions "have the population in common, only" (as a programme manager declared). While the historically existing bureaucracies will impede such sharing processes, the action-net created can try and provide the impetus for the establishment and institutionalization of these new practices.

At the time of writing, the dashboard is functional and in use, although it is still not fully part of the health department routines. It would probably take months or more to get embedded into consolidated practices, therefore to enact an organizational change. The first step on this way is the improvement of reliability of data provided. The validation rules embedded into the software, and the training courses organized for medical officers have positive effects on health personnel ("eye opener training", "we get to see things which we had been unable to see on paper, somebody brings paper and we simply sign", "what we have done before was not visible, today it is becoming visible, we're blindly signing so today we are feeling guilty" are some of the medical officers' quotes reported by one of the trainers).

A concrete obstacle to institutionalization is the personnel high turnover at all levels. The health department's IT consultant who contacted HISP left after a few months the project started, when she was still acting as a catalyst for the action-net constitution. A few weeks before the contract to scale up the system statewide was to be discussed, HISP's reference within the health department left. All those months have been characterized by the concern about the displacement of the health commissioner before a Memorandum of Understanding would have been signed.²

As action-nets are initially based on tentative, informal, and several times improvised connections, the frequent change of people is a continuous challenge for the establishment and consolidation of action-nets. This is particularly relevant in a context, like the Indian, where hierarchies are strict, and new personnel are not always available to engage in alliances not completely congruent with the structures already in place.

Through this process, HISP is learning, too: HISP action-research, in India and in other countries as well, is based on its ability to learn through the theory-intervention continuous interplay. Indeed, more empirically, the new action-net focused on medical and organizational issues is increasingly reflected in HISP India software design and development. The result of this learning in software development practices is making HISP more scalable, in institutional terms, and aims at contributing to information system research, for example through this article.

6.3. Action-Net around a Geographical Information System

Various research studies and practical examples have established the potential that maps hold to improve public health delivery, and also the challenges in developing effective GIS applications for this purpose [for example, Lewis: 2005]. The challenges come from a variety of reasons including the complexity of the technology, the non-availability of maps, and a weak culture around the use of maps in general in India [Walsham and Sahay: 1999]. These

² Anticorruption rules in Indian public administration impose frequent and sudden displacements of high officers. Moreover, HISP state implementation coordinator left after seven months of implementation, and the development team always risks people move to the higher-paid and rapidly growing Indian IT private sector.

challenges thus provide a high threshold for organizations like HISP to overcome, seeking to develop HMIS in which GIS is integrated. The capability to transcend this threshold thus provides a useful mechanism for locking in HISP, as a successful provider, into the everyday routines of the workings of the state health organization.

In Mahatmapradesh, the potential to transcend the inherent complexities came through collaboration with Geo-Info which was suggested by the IT consultant in the state health department. Geo-Info, a quasi government organization, has an established significant expertise in geo-spatial applications, and has the official mandate of the state government of Mahatmapradesh to develop such geo-databases and applications. Moreover, they are the agency designated with the ownership of the spatial databases, for which in Mahatmapradesh -because of security restrictions for bordering with Pakistan- is nearly impossible to obtain high-resolution maps with village level boundaries and the required layers. In a sense, it would have been impossible for HISP India to have developed a GIS for a public health application without Geo-Info. On the other hand, with a formal collaboration HISP had the potential to become an integral part of the institutional routines surrounding the use of spatial data. From the Geo-Info perspective too, the collaboration with HISP was beneficial for two reasons. Firstly, HISP had the public health expertise, something which in Geo-Info was missing. Secondly, for Geo-Info to effectively provide a GIS solution to the state health department, they needed the non-spatial routine health data, which was being collected through the DHIS 2.0. This mutual advantage situation arising from the collaboration was also facilitated through informal means due to an existing friendship between a senior HISP India researcher and the Geo-Info Director, which helped to establish the trust in each other's intentions and capabilities. Given this context for the creation of the action-net, the linkages were pursued through two key strategies. Firstly, a clear separation of the DHIS 2 and GIS applications, with HISP and Geo-Info independently responsibility of their respective applications. Secondly, a "loose integration" was made by establishing a technical linkage only at the database level, where software routines were created so that the routine data being collected through the DHIS 2.0 would be made available in the appropriate format to the GIS application, which could then use this data and display it on the maps.

In spite of these positive premises, the collaboration has not really produces the expected results in terms of actual use on the ground. A number of causes can be addressed:

- their software was not open-source, therefore all the adaptations for programmes and different organizational levels had to be done internally by "Geo-Info". The chair assured that necessary human resources would have been available, without considering their real entity;
- Although a joint HISP / Geo-Info team was appointed, HISP and Geo-Info code writers where in different places, both coping with other priorities. So, the collaboration was simply left aside in daily activities;
- The friendship between the members of the two organizations has facilitated the establishment of the connection, but the IT consultant's departure removed the facilitator for a formalization of the collaboration (at that point, the GIS was working on a limited set of data, and more resources than those which could have been informally made available were needed to carry on the development).³

³ Unavailability of source code implied that Geo-Info should have had adapted their import tool to DHIS, and to the requirements of diverse organizational entities (districts, blocks, vertical health programmes)

We propose this counter-example to the dashboard as relevant to highlight the need of establishing action-nets rather than only abstract plans to design and implement an information system.⁴

7. Scaling Health Management Information Systems by Institutionalization

An important aim of this action-research is to explore the potential to provoke *organizational change within a bureaucratic system* such as an Indian state health care system. In this, the role of *HMIS is central, as far as information can be used for learning and action*. This section draws from concrete examples, to make the point of creation of action-nets, their institutionalization as the way to scale up a HMIS.

As far as we focus on social networks or organizational fields, we cannot make much sense of the differences between the two cases described previously. The main reason we provide to explain why the Dashboard is on the path of institutionalization, and the GIS is not is that the former has been built by constituting an action-net, whereas the latter's implementation was designed in abstract terms and not on existing and potential courses of organizational action.

On the other hand, institutionalizing a HMIS does not mean accepting organizational routines as they are. Since the concept of use of indicators was a relatively new concept in the health department, there was an inherent ambiguity from the state side on who should be involved in the discussions and who has the responsibility and authority into taking decisions around "what is the accepted and official list of indicators." If new action-nets reproduce existing routines, learning is not likely to take place. So, in a sense this ambiguity has allowed cooperation, as it would not have been possible otherwise because of fixed procedures that regulate the flow of information and the establishment of interchanges. This process of negotiations around the indicators definition -facilitated through the external agency of HISP-can be seen as catalyzing the creation of an action-net which aims at reducing department's inner compartmentalization, based on the argument that fundamental information flows need to be integrated. Unlike the boundaries of formal organizations, which are formally and officially defined, the boundaries of the managerial action-net supporting the 'dashboard' tend to be more fluid.

The process of negotiations -and varying institutional conditions in which the implementation is taking place- helped in constituting the dashboard's action-net. The DHIS acted as a boundary object between those actors and their practices. This introduces the need to highlight the main boundaries that have been encountered until now, where activity is more fluid, therefore where other-than-hierarchical alliances can be more easily established:

⁴ As an example of the plan for the GIS, we can quote an our own excerpt from our previous submission (five months ago): "the interesting feature of the GIS is that, there has been no need for ongoing and continuing negotiations to institutionalize and scale up the processes, but the inscribed technical routines are "speaking on behalf" of the two organizations, and holding them together. The institutional conditions, including the issues of expertise and ownerships of mutually required data (routine non-spatial and maps respectively from HISP and Geo-Info) promise to provide the framework with which the action-net can be institutionally consolidated, thus sustained. However, it is important that the application is effectively taken up by the user departments (specifically by the medical fraternity at all levels). Only when the system proves useful in their practices, will the mechanism for scaling be provided. Towards this end, Geo-Info and HISP are planning to run long term and intensive training programs for the users." (This quotes underpins the importance of reflexivity to produce learning)

- State health care department/HISP India: the public administration and the NGO rely on different sources of accountability, meaning that the patterns of action considered normal in a bureaucracy and in a not-for-profit organization are not always aligned.
- Geo-Info/HISP India: they kept complete autonomy and tried to interact nearly exclusively through developing the software linkages.
- BHO, district and state: information flow should meet more precisely control and planning activities. DHIS 2 is being positioned as the "obligatory passage point" through which all reports need to flow.
- Computer-based / paper-based information system: the reporting system is currently mixed, with the vision of slowly reducing the paper component at the expense of the other.

The action-net fluidity can be a potential site for organizational learning to occur. The example of the 'dashboard' development illustrates the potential that such artifact has as boundary object, to facilitate the creation of action-nets which subsequently can contribute to processes of institutionalization.

8. Conclusion

The existing organizational structure *tends to support a separation of the two lines of information and action within the health organization: the bureaucratic and the managerial.* For example, the people who understand the content of what the indicators are, and how they can be used, often are not fully included in the decision-making processes involved in defining the functioning of the HMIS. This means that relevant information risks not going beyond closed circles, being accumulated as a fulfillment for bureaucratic duties, rather than being used for planning. This keeps information availability dependent on particular power and interests, and is challenged by the establishment of action-nets oriented towards learning and organizational change. Former tendencies could potentially impede information systems' design and implementation as a 'development'-provoking practice. On the basis of this, future research will continue to consider if the system under development is producing learning, organizational change and institutionalization (as far as it enacts and/or produces recognized practices, it gets institutionalized, therefore spreads out and scales).

While it is still relatively early to evaluate the effectiveness of this project, participant observation reveals that some taken-for-granted routines have been addressed, and changed, initiating new action-nets. They are, and need to be, more fluid then the bureaucratic reporting activity in order to keep adapted to the changing health needs from the environment the health care system is dealing with.

A non-definitive answer to the research question is that, in order to get institutionalized, action-nets need: a) to find entry points into existing organizational procedures (it can be easier to get into them if they are fluid to a certain extent), b) to intersect different practices and leverage on the boundaries between them, c) to be continuously followed when they emerge, oriented by situated actions, rather than abstract plans [Suchman: 1987]; therefore, managed locally.

It is difficult, at this point at least, to define some typology of effective (and institutionalizable) action-nets. The main contribution this article aims at making is to argue the relevance of looking at scalability as an institutionalization process, which needs to take place constituting proper action-nets. Any achieved result would be, the process is showing that *organization through information systems is a practical accomplishment, rather than a linear implementation of a rational design.* This posture is in line with Orlikowski's [2000], who argues that, in order to be enacted, *technology should be learned rather than transferred (the two cases show different aspects of learning processes).* This case suggests that

institutionalization requires the ability and attitude to learn, and this depends on the ability to reflect and also to unlearn (paper based report practices, for example), *on both sides*. Rather than a list of recommendations, we think that this practice-based approach is the main contribution to the broad community engaged in information systems in developing contexts.

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