Journal of the Association for Information Systems

Volume 10
Issue 5 *Special Issue on e-Infrastructure*

Article 4

5-28-2009

Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India

Sundeep Sahay
University of Oslo, sundeeps@ifi.uio.no

Eric Monteiro
The Norwegian University of Science and Technology, eric.monteiro@idi.ntnu.no

Margunn Aanestad
University of Oslo, margunn@ifi.uio.no

Recommended Citation
Sahay, Sundeep; Monteiro, Eric; and Aanestad, Margunn (2009) "Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India," *Journal of the Association for Information Systems*, 10(5), .
DOI: 10.17705/1jais.00198
Available at: https://aisel.aisnet.org/jais/vol10/iss5/4

Journal of the Association for Information Systems
JAIS

Special Issue

Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India*

Sundeep Sahay
Department of Informatics
University of Oslo
sundeeps@ifi.uio.no

Margunn Aanestad
Department of Informatics
University of Oslo
margunn@ifi.uio.no

Eric Monteiro
Department of Computer and Information Science
The Norwegian University of Science and Technology
eric.monteiro@idi.ntnu.no

Abstract

Information Infrastructures typically evolve in an incremental fashion, through partly planned and unplanned processes. A significant mechanism of growth is when previously unconnected systems are integrated, facilitating the transition from networking to inter-networking. Conversely, failure to integrate systems contributes to the lack of evolution of the infrastructure. Integration seems crucial for evolving infrastructures; however, there is little consensus on what it entails, as can be seen when different connotations of 'integration" are unpacked. In contrast to the dominant view of integration as a largely technical concern, our focus is on how political and institutional interests are embedded in efforts to achieve integration. More specifically, we explore strategies for institutional integration that take into account uneven distribution of political influence. The paper builds on empirical material from our ongoing (2001 – 2008) involvement with the problem of fragmented information systems in the health care sector in India. The case is seen from the perspective of one small actor offering free, open-source software that is already being used in several other developing countries. Choosing to focus on a small actor highlights the asymmetric power relations among the actors; our actor has no other option than to seek to align with bigger and more influential actors. We analyse the strategies, the configurable politics, and the outcomes of the distinct configurations that emerge from this form of asymmetric integration.

Keywords: *integration, health care information systems, HISP, India, politics*

* Paul Edwards, Geoffrey C. Bowker, Steven Jackson, and Robin Williams were the guest editors.

Volume 10, Special Issue, pp. 399-414, May 2009

Configurable Politics and Asymmetric Integration: Health e-Infrastructures in India

1. Introduction

The growth trajectories of stand-alone technological artefacts differ significantly from large-scale, inter-connected — i.e. infrastructure – technology. The field of large technical systems consists of historical accounts of the development of infrastructures including railroads, sewage systems, and highways (Summerton 1994). An exemplary case is Hughes' (1983) description of the establishment of electrical power supply systems on the east coast of the US in the latter half of the 18th century. Predominantly, this field has emphasised evolutionary, path-dependent change processes that ultimately lead to stabilisation. ICT-based infrastructure technology, e-Infrastructure, exhibits characteristics similar to those of other infrastructures, e.g., of path-dependencies (Hanseth et al. 2001, 2006, Kallinikos 2004). Far less attention is devoted to (more) radical change (but see Egyedi and Verwater-Lukszo 2005; Hanseth 2001, and Geels 2007 for exceptions). Often these radical change processes arise due to political events, as illustrated by Silva's (2002) description of how post-war crisis in Guatamala paved the road for the delegation of responsibility to consultants for the design of information systems in hospitals.

A characteristic, arguably defining, aspect of e-Infrastructures is their configurability — both technical (Fleck 1988, 1994, Williams, Stuart and Slack 2005) and interpretive (Orlikowski 1992) which inscribes in them the potential to evolve (or not) over time. These e-Infrastructures, by their very definition, need to adapt, interconnect, co-evolve — in short, integrate with other systems — in ways that are poorly understood in research, in terms of patterns of development, innovation, and use. Strong business trends favor ambitious, generic software packages (e.g., enterprise resource planning systems, content management publishing systems, or customer relationship management systems) that presuppose the possibility of extensive local adaptation in the form of configuration through calibration of various technical parameters (Pollock et al. 2007). Likewise, the wrapping of complementary components or applications into portfolios or services is propelled by the apparent ease of integration of ICT artefacts (as claimed especially by ICT vendors).

IS literature over the last two decades has emphasized the social and political construction and use of IS applications (Orlikowski 2000; Williams et al. 2005), strongly suggesting that integration should be treated as much more than a technical process. This problem gets magnified in the case of e-Infrastructures, which, by their nature of being constituted by a diversity of systems, standards, and uses (for example, the Internet), have a multiplicity of social and political interests inscribed in them. Thus, it is fair to hold that our current conceptualisation of the full implications of the qualifier "integrated" in connection with information systems leaves much to be desired (see, e.g., Boudreau and Robey 2005). Specifically, we have little empirically based knowledge about the interplay of the political and technical configurations that arise during attempts to integrate multiple ICT systems.

The aim of this paper is to explore the implications of the configurational aspects (both political and technical) of ICTs stemming from trends of integration, which ultimately provide the constitutive element in the formation of modern e-Infrastructures. In our analysis, we try to unpack and analyze these configurational elements, both with respect to the technical systems of the e-Infrastructures and the political manoeuvring that is embedded around and within it. Empirically, the analysis is based within the public health sector of a developing country (India), where political and institutional aspects of integration are salient. We specifically focus on two different sets of actors (large and powerful vs. small and relatively powerless), the systems they are trying to introduce within the same setting, and the political capacity and credibility they each bring to the table. More specifically, the aim of the paper is to analyze how the interplay of the political and technical configurational aspects of IS applications shape processes of integration. Understanding this interplay provides rich insight into the dynamics of integration in the context of e-Infrastructures, providing is a contribution to the research field, which has largely focused on the technologies and techniques of integration.

The rest of this paper is organized as follows. In section 2, we discuss how integration has been conceptualised in IS research. Information the empirical data from a health information systems project in India is presented in section 3, and the case study in section 4. Analysis and discussion follow in section 5 and we conclude with section 6.

2. Conceptualising Integration in IS Research

"Integration has been the Holy Grail of MIS since the early days of computers in organizations" (Kumar and van Hillegersberg 2000, p. 23). Within the domain of health information systems, too, integration is a normative goal stipulated by international agencies like the World Health Organization and national governments. The current thrust of the World Health Organization is the creation of national enterprise architectures intended to facilitate extensive integration:

> *"The enterprise architecture is the next level of elaboration of the [framework] where general lessons, standards, and processes can be aggregated and documented for knowledge sharing. A well-thought-out and collaboratively supported architecture enables systems to be built and implemented using consistent standards for data collection, management, reporting, and use. The components of the enterprise architecture will be adapted from or collaboratively generated with the global disease programs whose buy-in and endorsement is crucial to its success. Investments in health information systems can be aligned and leveraged around such architectures to build stronger core health information systems supporting better local health services management, health policy and ultimately stronger health systems" (Stansfield et al 2008, p.1).*

Despite the long-standing and increasing focus on integration, the existing literature within both the IS and health information system domains remains overly optimistic and prescriptive, often touting new and better technical approaches to deal with integration (see e.g Chari and Seshadri 2004; Grimson et al. 2000). However, there are alternative views to this emphasis on the technical aspects of integration, which we will review further below. Our concern for these alternative perspectives on integration was initially empirically motivated. Through our engagement with the challenges related to health information systems in developing countries, we have witnessed the significant negative effects of fragmentation caused by a multiplicity of technical and manual systems, typically introduced by various donor, governmental, and vendor interests (Heeks 2008). The existence of multiple information systems creates redundancy and additional workload for the already over-burdened health workers responsible for both providing clinical care to large numbers of patients and carrying out various administrative tasks including those related to health information systems (Mosse 2006). The kind of health information systems we focus on support local collection and processing of data relating to health status, disease incidence, prevalence, services rendered, infrastructure and the catchment population. Due to redundancy between systems, health workers may have to report the same data several times: for example, both in the routine reports (within the districts) and in program-specific reports of so-called "vertical" health programs (e.g., on malaria, tuberculosis and HIV/AIDS). Poor coordination and linkages between and across health programs adversely influences both health delivery and the quality of the reporting systems (Braa et al. 2004). For example, the HIV-positive, pregnant women who are enrolled under the Mother and Child program for antenatal care services may fail to show up in the Prevention of Mother to Child Transmission program, which comes under the umbrella of the HIV/AIDS program (Shidende 2005). Recognizing these various challenges in the health sector, both international donors and national governments are extolling the virtues of integration, but unfortunately, they often do no more than extol the need to buy more sophisticated technologies to link these multiple systems technically.

The public health domain discussed above presents uneasy similarities with current IS research, where, again, integration is predominantly conceived of as a technical issue, and the emphasis is on different mechanisms and strategies for achieving tighter integration (Hasselbring 2000, Grimson et al. 2000). We elaborate on this trend in more detail below.

Traditional View: Integration as A Remedy

Since the 1970s, Western business organizations have struggled with the fragmentation of their collection of information systems (McNurlin and Sprague 2001) and looked for ways to integrate them by defining standards for common services and building shared information repositories, terminologies, and technical platforms. Technically, integration refers to the degree of interoperability and interconnectivity among technical components, and relies on standardization at a certain level.

Over the last decades, a rich and expanding repertoire of technical mechanisms for integration has been proposed, from low-level (e.g., database schema integration), to middle-level (e.g., middle-ware like CORBA, Web services), to high-level (e.g., Service-Oriented Architectures (SOA)) solutions (Chari and Seshadri 2004).

The high level of uptake of so-called Enterprise Resource Planning (ERP) systems in large business organizations is a poignant illustration of the need to address integration. SAP, the world's market leader in ERP systems, points out on its web site that the goal is to have business processes "[integrated] ….across departments and functions." Yet organizational implementation lags significantly behind these promised returns (Goodhue et al. 1992, Hanseth et al. 2001, Kallinikos 2004, Pollock and Cornford 2004, Singletary 2004). The traditional approach to integration, in short, remains overly optimistic, prescriptive, and programmatic.

The Downsides of Integration

There are critics of the one-sidedness of the technically focused position on integration. Goodhue et al. (1992) have emphatically called for a more nuanced approach to analyze this complex issue. Working out a pragmatically based contingency model, they identify conditions under which the costs (in terms of loss of flexibility, increase in development costs) may outweigh the benefits of integration. Similarly, and more recently, Singletary (2004) found that practitioners saw the downsides to integration as lock-in with vendors, costs, and project risks (see also Markus 2001). Empirically underpinned case studies (see e.g., Hanseth et al. 2006; Rolland and Monteiro 2006; Perrow 1984) demonstrate in a more detailed way the form and implications of the unintended consequences of integration. As the complexity of systems increases with tighter integration, so does the likelihood for unintended effects of any action taken. Thus, the wished-for integration may not emerge, and increased control over fragmented systems may not be achieved.

Political Ecology of Integration: "Asymmetric Integration"

The contributions cited above document the unintended consequences of integration but present little analysis of why and how they occur. We argue that achieving an understanding of these deeper questions involves placing greater emphasis on the political and institutional conditions that envelop and shape the context and processes around the dynamics of integration. A political perspective on IS, in general, and integration, in particular, highlights the importance of gaining, maintaining and expanding the political and institutional legitimacy and support for an IS (Cox and Ghoneim 1998). For instance, within a business sector, dominant actors can design integration solutions that define and solidify trading relationships and reinforce their dominant role (Webster 1995). The fate of integration initiatives often seems to "hinge on the wider issues of inter-organisational relations" (Spinardi et al. 1997, p. 260).

Nowhere is this perspective more appropriate than within the thoroughly politicised arena of the health care sector, especially in developing countries. Systems, whether stand-alone or attempting to be integrated are deeply embedded in the politics of diseases, donor money, national and local government agendas, the battle of vendors and systems, and the direct concerns of civil society (Avgerou and Walsham 2000; Heeks 2008).

At the core of our analysis is our emphasis on the need to acknowledge the role of political and institutional factors. The fragmentation of technical systems cannot be seen in isolation from the very diverse political interests of the donors, the countries and politics they represent, the money they bring in, and the particular diseases in which they are interested. The various reporting systems are heterogeneous technically (in terms of application, platform, protocols, language), in relation to funding mechanisms (from government, donor agencies, universities, the World Bank, or local municipalities), and with respect to institutional grounding (central ministries, district administration, local health clinics, vertical programs). This heterogeneity in politics and institutions must be accounted for and must not be superseded by technical aspects of integration (Chilundo and Aanestad 2005).

An implication of our focus on the political aspects of integration is the importance of aligning new information systems with the existing institutions' agendas and concerns. Specifically, as we will demonstrate in the case narrative below, small and relatively non-influential actors have to carve a niche for themselves without intervening unduly with the existing practices and routines (Braa et al. 2004). Technically, this corresponds to unilateral integration by only importing from and exporting to the existing systems rather than indulging in more challenging bilateral interaction. Politically, it involves forging alliances with the existing institutions. We refer to this as "asymmetric integration" to acknowledge how it mirrors the existing, uneven distribution of power and resources among the stakeholders.

3. Research Methods

The empirical material reported here is drawn from experiences gained during the implementation of the Health Information Systems Program (HISP) project in India. Part of the empirical material comes from Andhra Pradesh, which is a state in southern India with a population of 75.7 million. The state has about 1,386 primary health centres and 10,568 sub-centres spread across 22 administrative districts covering an area of about 246,793 sq km. The material is supplemented with experiences from Gujarat, another state in Western India that has a population of around 50 million and is divided into 25 districts. Gujarat state has 1070 primary health centres and 253 community health centres.

Data was collected through a variety of means, primarily by the first author, who was intimately connected with the day-to-day running of the projects. This includes an uncountable number of formal and informal interviews with staff at all administrative levels and observations and assessment during actual project management activities. Various evaluation reports were also prepared for the state as submissions on the projects status. Thousands of emails were exchanged with the project team members and also with the health department staff. These provide a rich account of the ongoing activities of the project as they unfolded over time. The first author spent a large part of his time during the last seven years with HISP India, a NGO engaged in the design, development, and implementation of health information systems in various states in India. The second and third authors participated in four field trips install lasting 10-14 days during the last three years.

Data gathering went beyond more traditional research methods for data collection and analysis, and included activities focused on building technical systems and integrating them with already existing systems; Further, and perhaps more important, the activities involved an ongoing cultivation of political support for the HISP project. These political configurations exist in a context that is highly political and charged — for example, the changing of governments and the introduction of new donors and their systems — making nothing stable or given. Maintaining, strengthening, and expanding these political relationships within this charged and changing political scenario is a vital (yet maybe "invisible") prerequisite for HISP activities.

4. Case: Integration of Health Care Information Systems In India

HISP is an acronym for the Health Information Systems Program, which is not a singular, defined project, but is spread globally as a loose network of projects and partners involving various academic institutions and governmental and non-governmental health institutions. The project is based at the University of Oslo, Norway, and includes various nodes in several African and Asian countries (see Braa et al. 2004, and www.hisp.org). Building networks involving developing and developed countries with the goals of improving health services, building capacity and developing and supporting open source software tools is an important focus of the HISP network. The District Health Information System (DHIS) is a software application developed by this network to support the collection, usage, reporting, and analysis of routinely collected activity data seen in conjunction with other relatively "semi-permanent" data concerning population, infrastructure, and locations of people and facilities. The DHIS software comes in different versions and has development groups in Norway, South Africa, India, Vietnam, and Ethiopia.

We now provide descriptions of two specific cases of integration — technical and political — carried out by the HISP India team in the Indian states of Andhra Pradesh and Gujarat.

Integration with FHIMS in Andhra Pradesh

In Andhra Pradesh, a southern Indian state, the former Chief Minister, Chandrababu Naidu, initiated during his tenure (1994-2004) various IT-powered reforms aimed at "good governance," including in the health sector. Our case describes the evolving relationship between two actors (the state's Health Department and HISP), each with its own software application, which at one stage became integrated. In the table below, we summarise central details on the actors and applications.

Table 1 Overview over the actors and applications in Andhra Pradesh

Name of actor	Name of software	Functionality	"Role"
The state of Andhra Pradesh (Health and Family Welfare Dept.)	FHIMS (Family Health Information Monitoring System)	Comprehensive health information system, based on registry of household names.	Front-end data entry tool, used by health workers to generate work lists. Exports of monthly data to DHIS.
HISP India (the local NGO, part of the Health Information System Program)	DHIS (District Health Information System), a free and open source software application	Health information system for aggregated data. (DHIS has both data entry, and reporting and analysis functionality)	Back-end tool for report generation and analysis. Offers facility-level analysis, GIS and web functionality.

The Family Health and Information Monitoring System - FHIMS

Around 2001, the Commissioner of Family Welfare within the Health and Family Welfare Department planned to embark on an ambitious project to develop a comprehensive health information system. This would not be based, as is customary, on statistical data (e.g., number of disease cases from health facilities), but on registration by household names, with the family as the basic unit. The development of the FHIMS (Family Health and Information Monitoring System) software application was contracted to a government firm at a cost of about US$ 68,500. The requirements included 17 modules, including those for family welfare activities, tuberculosis control, leprosy eradication, budget monitoring, personnel information, etc. (see Table 1). The health department mobilised about US$ 7.3 million for the project through a consortium of funding agencies, including the World Bank. The funds were used to buy about 1,500 computers and install them in every primary health centre and district office as well as in the state office, and to load them with Oracle (with a license fee of about US$ 200 per computer) and Microsoft software (Raghvendra and Sahay 2006).

The Chief Minister attempted to introduce systems of modern governance that would integrate all state, supported social services; thus, he embarked on a futuristic vision to create a personal identification system (however, using households rather than individuals as the unit of analysis). This was to be based upon a Multi-Purpose-Household-Survey. Household-level details gathered through this survey would serve as the basis for citizens to receive integrated services (health, education, caste benefits, etc.) from the state government delivered primarily through the web. Also, the health department's FHIMS system was supposed to use the results of the survey to track the usage of health services over time by individual households. However, it was soon realized that this survey, primarily owned by the Revenue Department, was unsuitable for use by the Health Department due to poor quality, and the fact that many health-related parameters were not included (Raghvendra and Sahay 2006). The health authorities soon decided that health workers would need to conduct an entirely new survey. The existing field staff subsequently conducted the new survey under the adverse conditions of limited time and resources, as well as an already heavy workload. Data collected through this house to house survey was of varying quality; never the less the next stage of the project was to enter the collected data into the FHIMS database. This data entry task was outsourced to a private party, which conducted the task without benefit of interaction with the health staff or training on the software and its utility for their work.

Nearly two years later, the household survey data entry was only 50-60 percent complete, and the computers were lying in a state of general non-use in the clinics. The staff saw the FHIMS software

as extremely rigid. Even introducing a new organizational unit required the vendor's intervention, which was not easily forthcoming, primarily due to contractual ambiguities and the rigidity in software design. The Health Department had limited technical competence and few dedicated resources for software support, and, thus, the application had limited value on the ground. An evaluation carried out in one district after the data entry contract was completed confirmed this point: No data had been entered in this software in 78 of the district's 84 clinics during the previous 12 months.

HISP India is promotion of DHIS

HISP India started working in Andhra Pradesh in 2000, at the same time as the FHIMS development and piloting processes, although in another district of the state. Access for HISP was enabled through one of the researcher's prior contacts with the Special Secretary IT to the Chief Minister. The researcher developed a proposal to pilot the HISP project in the southern district of Chittoor which was accepted by the government. Initially, despite some scepticism from the health department and FHIMS vendors about the low-tech nature of the HISP project (then based on a Microsoft Access platform) as well as the lack of hardware and funding, the HISP team started the situation analysis. This involved seeking to understand the organisational structure and health information flows by visiting various health facilities in the district and interviewing relevant functionaries, as well as conducting participant observation and discussions. A key aim of the situation analysis was to rationalize the data flows and develop a "Minimum Data Set" that would include the set of minimum data items that should be collected by the different types of health facilities. The situation analysis identified high levels of redundancy in the existing datasets; with some data being collected repeatedly to comply with the different program-specific reporting formats, including for programs that had long ended (Puri et al. 2004). By September 2001, more than 1,200 existing data elements had been reduced to around 400, and the reports restructured and reduced to about 10 (Puri et al. 2004). However, the Health commissioner did not give official permission for HISP to implement these changes, as he was revising formats at the state level.

HISP encountered stiff resistance at the state level, partly arising from the historical fact that their project had been initiated through the chief minister's office rather than the health department. The commissioner refused formal permission to implement DHIS, stating that the department had already committed itself to FHIMS and did not wish to confuse its implementation by also allowing DHIS. After extensive persuasion, the Commissioner consented to sanction one computer and promised to send a letter to the District head to permit HISP to pilot the project in one primary health centre in Chittoor. We were subsequently informed by the district staff that neither the letter nor the sanctioned computer ever arrived. Over the phone, the Commissioner had, in fact, told them not to allow HISP to make any changes in the report formats. Subsequently, HISP manoeuvred an opportunity to make a presentation to the Chief Minister and his senior advisers from the health and IT departments. The Chief Minister was appreciative of the aims and approach of the project and sanctioned 12 computers, one each for the nine primary health centres of Kuppam (the electoral constituency of the Chief Minister) and the rest for the district office. DHIS implementation was initiated in these facilities.

Growth of the DHIS implementation and continued tensions

At the end of 2002, the project was extended to the Madanapally revenue division, consisting of 46 primary health centres including the nine from the earlier phase of the project. With political support from the Chief Minister's office, HISP was invited in October 2003 by the Commissioner of Health to sign a formal agreement between her office and the University of Oslo. The agreement sanctioned US$35,000 to purchase computers, hire trainers to conduct capacity-building activities, and support some development costs. However, six months after the completion of the Madanapally revenue division project, the Commissioner was again keen to stop HISP, and its activities were again thwarted through political pressure. However, the positive evaluation of the work had helped HISP to gain another extension, this time to implement DHIS in all the 23 district capitals of the state and to create a web-enabled state-level database. Further, as a new task, HISP was contracted to design and implement a system for monitoring maternal and infant deaths. Interestingly, another facet of the project was to provide implementation support for the FHIMS project in the Nalgonda district which was by then facing quite serious implementation problems.

Despite this request to support the FHIMS project, there continued to be explicit tension between the two initiatives. With the Health Commissioner's continual reluctance to provide HISP with permission to proceed, district FHIMS authorities started to uninstall the DHIS software from some of the computers and instructed the health workers not to use DHIS but only FHIMS. As a result, the DHIS, despite having very useful technical features (such as the integration of the routine data with maps) remained practically unused and not "owned" by the state health department. In an attempt to break this deadlock, the HISP team presented a proposal to integrate DHIS software and FHIMS, which the state approved in June 2005. We now describe this integration phase.

Integration of DHIS with FHIMS

In order to succeed, the proposal for integration had to preserve the concerns of both actors (the State and HISP) and to offer added value. The integration involved reformulating the problem — from collecting household data and its automation — to developing better analysis capabilities at the facility, district, and state levels. The underlying principle of the integration proposal was that, while FHIMS would be used to enter name based data and generate name-based reports (for instance, to identify, schedule and locate service appointments for individuals), DHIS could provide the facility-level reporting and analysis, incorporating particular value-adding functionalities such as Geographical Information Systems and a web interface. Practically, field health workers registered the name-based data in the FHIMS, which the health facility workers would aggregate, convert to a text-file and import into the DHIS at the end of each month. Facility-based analysis involving maps, charts, and tables would be generated at this point.

Technologically, both DHIS and FHIMS had something to gain through this integration. FHIMS provided the name-based data, which was very useful for the field level workers to develop their weekly work schedules. And arguably, the name-based data was more reliable than aggregated information, as it could not be so easily manipulated (since there was an element of fear amongst the health staff that manipulations [of names] could be traced). FHIMS also gained as the integration with DHIS now allowed aggregated analysis to be conducted on data stemming from FHIMS. However, politically, there was an asymmetry: the entire state machinery (resources and commitment) was behind FHIMS, and DHIS was seen as an intrinsic outsider that needed to be kept at bay lest it threaten the existence of FHIMS. The integration did provide DHIS an entry point into the state system, which until then the state had been trying to prevent.

The commissioner approved the piloting of this integration project, again with some persuasion through the political channels, and because it was presented as being relatively non-interfering with the FHIMS project. Without going into the details, this project was seen as successful because the HISP team was able, first, to have the FHIMS database up to date in all the 84 primary health centres of the pilot district and second, to train the health staff to independently generate the required reports. After four months of the project, nearly 75 of the 84 primary health centres were generating and submitting the promised integrated monthly facility reports. Such an achievement had not taken place earlier in any of the other districts where FHIMS was being implemented. These results were presented to the authorities and formed the basis for arguing for a state-wide extension of the integrated model.

Political events undermining further growth

In the state elections in 2004, the Chief Minister who had been a supporter of HISP was dramatically voted out of power. The IT advisor, who was HISP's strongest supporter, also left for an overseas posting. The new Commissioner was very conservative and used the argument that "a decision is a decision is a decision" as the basis for continuing with the state's FHIMS deployment, notwithstanding its serious implementation problems and the positive results from the FHIMS-DHIS pilot integration. He also was perceived as being very anti-technology and asked the HISP president "How will your computers help to prevent mothers from dying in our health facilities?" Subsequently, he officially terminated the HISP project. With HISP no longer operational in Andhra Pradesh, the team continued to have good relations with the Secretary of Health, who in September 2006, invited HISP to implement the project in two districts, using money from sources independent of the Commissioner's funds. However, before HISP could send in this proposal the next day, the Secretary of Health was

transferred to the Revenue department. In early 2007, HISP India was invited again to participate in meetings with state officials about how it could support the FHIMS project, which had not delivered results despite the significant amount of time and money invested. However, consensus could not be achieved on what should be the way forward – whether resources should be spent on reviving FHIMS or scrapping it and re-starting afresh with HISP. The HISP team was asked if they could help to revive FHIMS, but it refused, arguing that there was a fundamental mismatch of ideology between the two approaches. Also, by this point, HISP was working in a number of states, and felt they that it could avoid the dictated terms that previously had been forced to accept when just starting out.

Integration of DHIS with Pragati in Gujarat

Early in 2006, an IT consultant in the Department of Health in the state of Gujarat approach HISP India to explore the possibility of designing, developing, and implementing an integrated health information system for the state. In response, the HISP team presented on overall plan, with an emphasis on linking the DHIS with a local Geographic Information System (GIS) (Puri and Sahay 2007). The table below sums up basic information of the integration of systems in Gujarat, which is described in the following section.

Table 2 Overview over the actors and applications in Gujarat

Name of actor	Name of software	Functionality	"Role"
BISAG (The Bhaskaracharya Institute for Space Applications and Geo-informatics)	Pragati ("Progress")	Geographical Information System for the public sector of the state of Gujarat	Analysis tool: contained the maps, and generated spatial analysis of imported health data from DHIS.
HISP India (the local NGO, part of the Health Information System Program)	DHIS (District Health Information System), a free and open source software application	Health information system for aggregated data, data entry, reporting and analysis functionality	Front-end tool for data entry and reporting, export of non-spatial data to Pragati.

Integrating DHIS and Pragati

Following the HISP presentation, the Department of Health invited HISP to conduct a pilot project in one district. While HISP was independently responsible for the health information systems design for the non-spatial data, the GIS functionality was to be implemented in collaboration with BISAG (The Bhaskaracharya Institute for Space Applications and Geo-informatics), a quasi government agency responsible for the state's spatial database. This agency had developed map-based systems for various public services and entities. As a result of its mandate to manage the spatial applications for the public sector in the state, BISAG served as an obligatory passage point (Latour 1987) through which the integrated health information systems project needed to pass. In addition to being responsible for the spatial databases, BISAG had developed its own GIS package called Pragati (meaning "Progress"), which was used in their various applications. HISP was required to work with BISAG in order to help customize Pragati for the needs of the state health department and to integrate that with the DHIS.

The two parties agreed upon a "loose integration" model were for linking the two applications (Pragati and DHIS). Both systems used MySQL as the database technology, and while Pragati was based on Visual Basic, DHIS used Java. The loose integration model entailed linking the applications only at the database level, while the respective applications (for example, the reporting module) would be independent. HISP would need to define the queries to enable the non-spatial data in the DHIS database data (for example, of number of women given ante-natal check-ups in a contain month in a particular facility) could be extracted and made available to Pragati in the required formats, which could then be used for the spatial representation. BISAG owned the maps in the spatial database. This integration of the non-spatial and spatial data allowed the production of both straightforward displays and more advanced reports, e.g., overlays (of health services and infrastructure data). The

relatively symmetrical distribution of needs and resources (BISAG offering spatial data and requiring non-spatial data, HISP the opposite) led to an arrangement that constituted a win-win situation for both parties (Puri and Sahay 2007). The health department acknowledged that the integration of the two systems was successful at a technical level.

Challenges of maintaining the integrated systems

However, a number of subsequent events influenced the effective operation of the integrated system on the ground. First, there was a young information technology consultant in the health department who had a passion for GIS and had been the driving force behind the conceptualization and the development of the integrated system. For personal reasons, she left her post, and with that, the "social and institutional engine" behind the integration was lost. Second, BISAG is strategy was to conduct a large scale introduction of the integrated system, putting it in the primary health centres where DHIS was running, rather than just introducing it gradually at the state level and then to the districts. At the primary health care facilities, the infrastructure was not adequate to deal with the "heaviness" of the integrated system, and the institutional mechanisms had not been thought through carefully. The facilities had not established how the data would move from the facility to the district and state levels without Internet connectivity in place. Third, for the staff at the facility level (the HISP trainers and the health services staff), GIS was a new concept and very poorly understood. The staff did not have the capacity to deal with the technical problems that kept arising – for example, when the GIS application was started, the DHIS installation file was lost. Fourth, the DHIS as a technical system was constantly changing (new releases kept coming from the global DHIS development group, which had to be adopted by the Indian team), and simultaneously, the health department's reporting needs were rapidly changing. For instance, a new institution was created at the national level (called National Rural Health Mission), which sought among other things, information on the equity of service provisions. Thus, the National Rural Health Mission developed new reporting formats capitalizing each data element into three groups (Scheduled Castes, Scheduled Tribes, Others). These changes, both technical and institutional, meant that the queries designed to transfer the data from the DHIS to Pragati kept needing to be revised; however, no institutional resources or planning had been earmarked for this purpose.

Ousted by a competitor, the re-entering

There was one more challenge at yet another level. Supporters of a new government developed system positioned it as the one that should be used for routine health data, replacing DHIS. After a brief and rather intense struggle, DHIS was removed, and HISP was asked to wind up its activities in the state. And with that, the integrated application went into cold storage.

As an epilogue, in October 2007, HISP was re-invited to the state and is now engaged in a state wide implementation. The Vietnamese HISP team had developed a GIS module, since ceasing operations in Gujarat, which was now integrated in the very core of the DHIS application. In this integrated module, a common database brought together the spatial and non-spatial data. This application was now being implemented as one integrated package through a state-wide server. Since the technical and institutional control of the package now rested with one entity (HISP), the earlier problems of synchronization and control of maps was no longer an issue. Currently, state and district staff use the health-related maps extensively for planning purposes continue to encourage its use at the primary health facilities.

5. Discussion and Analysis: Toward Configurable Politics

When comparing the experiences from the two states of Andhra Pradesh and Gujarat, we see some of the effects of politics on the development and evolution of the information infrastructure. As stated initially, our perspective in this analysis is that of one actor in the game, a small and relatively powerless one at that. We elaborate on this actor's adaptive actions conducted in order to survive. We have chosen to analyse the experiences according to how the "configurations" of DHIS were adjusted, and before proceeding we will explain what we mean by this concept.

Fleck (1988,1994) coined the term "configurational technology" to convey the assemblage of complex

technical solutions through the selection of standard and custom components to meet the particular application requirements. The exact configuration remains flexible to accomodate local circumstances. This correponds to the concept of "bricolage" which Büscher et al. (2001) identify in the analysis of the design of workplace IS. Williams, Stewart and Slack (2005) carry this analysis forward to highlight the extent to which those setting up a project make choices that configure the "translation terrain" – the immediate arrays of actors involved and the relationship between them – with important consequences for the subsequent organisational politics and outcomes. For example, Koch (1997) has characterised as "Bricks and Clay" the uneven malleability for organisational users of large packaged solutions vs. locally-supplied assemblages of finer-grained components.

Building on configurational technology as an artful but constrained combination of a range of human/material, obdurate/malleable, and standardized/local components, we explicitly focus on how political and institutional components are configured over time and different dimensions. Specifically, we analyse the configurability of DHIS along four dimensions, which are interlinked: (i) the selection of components from a larger pool of possibilities to form a DHIS portfolio, (ii) the location of this portfolio with respect to other competing, collaborating, and partly overlapping information systems provided by actors external to HISP with uneven institutional and political status, (iii) the nature or quality of the linkages (e.g., are they uni- or bi-lateral?) and (iv) the temporal evolution, i.e., the changes over time in how this interlinked collection of systems is ordered.

In relation to the state's need for health information systems, the DHIS software could potentially serve different functions. For instance, DHIS could be the core system covering the whole process from data capture to, reporting to data analysis. It could potentially have replaced the previous, fragmented systems (e.g., those existing for disease-specific, vertical health programs). But DHIS could also take on a less central role and do just one or two of these tasks. In such a role DHIS only would serve the needs of other actors more or less invisibly. For instance, it could be used as the front-end data entry tool that exports data to other systems in use, offering a single data capture application with data validation functionality as an added value. Alternatively, it could be a back-end system that receives data from other systems and provides advanced and flexible analysis capabilities. In the Andhra Pradesh, case the DHIS was put in such a back-end role. FHIMS occupied the front end position, where health workers entered data and generated their work lists. The DHIS received from FHIMS a monthly report and, based on this, generated an aggregated data report. The inclusion of DHIS into the state's portfolio of systems was motivated by the added value its analysis functionality had to the health authorities. The facility-based reporting, the GIS, and the web-based functionality complemented the FHIMS. In the Gujarat case, the DHIS served as a front-end data collection tool for non-spatial data. As such, the DHIS software could have stood on its own as a health management information system. The link with the GIS (Pragati) added the possibility of providing map-based visualisation of the data that DHIS had collected and stored. Thus, we see that the role or location of the DHIS application vis a vis the other systems was very different in these two cases. Only, a subset of the software's potential functionalities were emphasised and exploited in each case.

This flexibility or configurability of the software allowed for significant leeway in the political manoeuvrings necessary to survive. As was described in the last section, the National Rural Health Mission recently prescribed new data formats (including the three categories of Scheduled Castes, Scheduled Tribes, and Others). Since HISP had developed the software to support these reporting needs for some other states, it could offer this as an existing solution to new clients (and when returning to Gujarat). This ability to reconfigure itself placed HISP in an advantageous position over its competitors, which typically have rigid software applications that are difficult to reconfigure in this way.

This flexibility, or configurability, of the software allowed HISP to present itself either as a competitor or a collaborator, depending on its choice, situation, and capacity. Thus, it was able to exploit the uneven and dynamically shifting political and institutional position of its collaborators. While a central and comprehensive role for DHIS would usually be the preferred option from the perspective of HISP, to espouse that wish could be counter-productive, and, thus, HISP presented a collaborator image to the other actors. HISP was able to present itself as an organisation that supports the implementation

of the other's aims through "asymmetric integration" thus adding value to the other's activities (e.g., through GIS functionality). In the DHIS-FHIMS link in Andhra Pradesh, DHIS was positioned as a back-end analysis tool that added analytic capacity. Its introduction in this manner was linked to the attempt to present it as non-interfering, and its survival strategy implied receiving legitimacy through its linkage with the large government-sponsored system. This state-sponsored strong backing of FHIMS eliminated the need to sell DHIS as the complete tool, instead, its analysis capabilities were emphasised, including geographical mapping. The link with BISAG's Pragati system in Gujarat was of a more complementary nature, where the needs and capabilities of two parties were relatively well matched. While the BISAG system certainly had more political legitimacy and power than the DHIS, there was a degree of symmetry in what each partner had to gain from integrating their systems, which had not been the case between DHIS and FHIMS. However, while there was a relatively symmetric division between BISAG and HISP in terms of cost, risks, and gains, the actual integration reconfigured the relationship and introduced certain dependencies. For instance, since BISAG's system depended on receiving non-spatial data from DHIS (for their health care application), there would be some consequences for Pragati if the DHIS database structure changed.

The dependencies introduced in the integration were another aspect of the configurability of the systems. For one thing, these dependencies were not necessarily equal in both directions. For instance, the DHIS-FHIMS-link was unilateral, and it was deliberately constructed so that DHIS did not depend or commit technically to the FHIMS. A flat .txt file was all that FHIMS needed from DHIS. The analysis would proceed in DHIS independently from FHIMS, and nothing was supposed to be sent back in a format that made DHIS depend on FHIMS. According to the HISP India president, this was intended so that "when FHIMS dies, we just cut the link and continue on our own." This indeed is the case now in 2009. The technical nature of the DHIS-Pragati link was more complicated, involving two-way dependencies, where the GIS-functionality of Pragati depended on data from DHIS. If the link did not work well, data was not available to health care managers (the DHIS users).

Another key facet of these configuration adjustments is *time*. HISP, with its open-ended, long-term perspective, resembled more a programme than a targeted, milestone-driven project. Hence the configuration — of social, material and political elements — evolved over time. Information infrastructures are, by definition, configurations that evolve over time. Nevertheless their trajectory is also shaped by the installed base. HISP had tried to remould its technical and political configurations to its advantage. An innocent-looking entry point may secure leeway for future reconfigurations and changes. In the case of Andhra Pradesh, the successful technical linking secured legitimacy and an advantaged position for DHIS in case FHIMS should be declared a failure. This did not happen, despite a good growth trend, but got disrupted in the aftermath of the election results and how they change the health administration. In contrast, in the second phase in Gujarat, the integration of the GIS module within the DHIS also gave it political strength and released its earlier dependence from BISAG. The point to make is that integration in information infrastructures is not a static, one-shot event, but needs to be seen in the perspective of time. Integration at one point creates the potential for future evolution, which needs yet other supporting conditions in order to materialize.

Thus, selection becomes a key component of the integration strategy. Selecting what to integrate, when, where, and with whom are crucial questions that implementation planners need to grapple with. Selecting the point of integration that makes the application "obligatory" is, of course, a desired strategy, from the point of view of those promoting that application. Along with being obligatory, it is also important to retain flexibility for independent survival in the event of failure of the integrated application. That was what was attempted with the FHIMS integration. Selecting the partner for integration is often not a matter of free choice but is constrained by the implementation situation, and is often driven by opportunistic considerations. In Andhra Pradesh, if the integration had been politically successful, HISP India would have secured the potential to scale up to the whole state, riding piggy-back on the resources and support of the FHIMS initiative.

Related to the time dimension of configuration, a particularly charged period is during tendering and procurement. Indian public institutions, as in many other developing countries, have rather ambiguous tendering processes. The "free" software connotation of HISP potentially ruled out the undue favours

that had often been expected from the vendors. This presented significant challenges to its adoption (Puri and Sahay 2008).

Thus, we see that varying degrees and kinds of interdependencies are built into these collaborative relationships (the technical solutions as well as the political alliances). This has an impact on the future development of relations and, thus, on the resulting information infrastructure

6. Conclusions

Our stated aim was to emphasize and explicate the political dimensions of integration, as seen from the point of view of a small entrant actor in an established domain with more powerful actors. We described some examples of how the DHIS application was positioned in the emerging ecology of health information infrastructures in two different states in India: Andhra Pradesh and Gujarat. We emphasised how there were different entry points that offered different opportunities and challenges, and how the overall configuration evolved over time.

The entry points can differ along several dimensions, and we emphasised the following: (i) A software portfolio or package can be configured through selecting and combining components from a larger pool of possibilities. (ii) This selection is motivated by an attempt to place this portfolio in a specific location or position with respect to other competing, collaborating, and partly overlapping information systems, typically provided by other actors. (iii) The expected role following from the positioning also influences the nature or quality of the linkages that are crafted. These choices determine which dependencies and potential risks are introduced or mitigated. In addition we emphasised how this interlinked collection of systems is not static, but changes over time. An initially non-threatening and collaboration-focused entry point may turn out to provide sufficient leverage to undertake a later expansion through reconfiguring the portfolio and changing its location and links.

Such strategic integration in an asymmetric power relation requires adaptability and flexibility. We believe this is a phenomenon of general interest. Building e-Infrastructures will necessarily involve issues such as those we have described here, where malleable applications and platforms are being configured, presented, and deployed in different ways. These configurations shift with location and over time. From the perspective of innovation studies, Fleck (1994) points out the necessity of ongoing configuration during implementation, reserving the term “innofusion” for this process. We build upon and extend the analysis of innofusion to explicitly address the political aspects of integration. More specifically, in settings with stark political asymmetries (e.g., HISP as a small actor struggling to gain visibility and legitimacy), flexible configurations are a prerequisite. In our analysis, we emphasise how flexibility to configure implies making decisions on location and timing, which, again, hinge on the actual political and institutional settings.

With respect to e-Infrastructures, development does usually not happen from scratch, but through the development of the installed base. We believe that one of the significant mechanisms of eInfrastructure development is of the kind described in this paper, where smaller actors try to enter the domain through an initially asymmetric integration strategy. The selection of entry points and carving out a strategy may have an influence on the resulting network, as studies of the economics of gateways show (David and Bunn, 1988). When a gateway is introduced between two competing networks, the power balance between them may be affected in rather unpredictable ways. It may lead to a tipping in the favour of one, or it may only strengthen the *status quo* through a relaxation of the need to choose one, just to mention two possible outcomes. Similarly, when a small actor like HISP pragmatically secured an asymmetric integration, this was just a starting point from which to proceed. As such, the asymmetric integration process can be seen as a generalisation of an evolutionary development approach.

References

Avgerou, C. and Walsham, G. (eds.) (2000) *Information Technology in Context: studies from the perspective of developing countries*, London, Ashgate.

Braa, J., E. Monteiro and S. Sahay (2004): "Networks of action: sustainable health information systems across developing countries", *MIS Quarterly*, 28 (3). pp. 337-362.

Boudreau MC, and D. Robey (2005): "Enacting Integrated Information Technology: A Human Agency Perspective". *Organization Science*, 16 (1), pp.3-18.

Büscher, M, Gill, SP, Mogensen, P and Shapiro, D (2001): Landscapes of Practice: Bricolage as a Method for Situated Design, *Computer Supported Cooperative Work*, 10(1), pp. 1-28.

Chari, K. and Seshadri, S. (2004): "Demystifying Integration". *Communications of the ACM*, 47(7), pp. 59-63.

Chilundo, B. and M. Aanestad (2005): "Negotiating Multiple Rationalities in the Process of Integrating the Information Systems of Disease-specific Health Programmes". In *Electronic Journal of Information Systems in Developing Countries*, 20 (2), pp. 1-28.

Cox, B. and S. Ghoneim (1998): "Strategic Use of EDI in the Public Sector: the HSMO case study". *Journal of Strategic Information Systems*, 7, pp. 37-51.

David, PA (1995): "Clio and the Economics of QWERTY". *The American Economic* Review, 75 (2), pp. 332-337.

David, Paul A. and J. Bunn (1988), " The Economics of Gateway Technologies and Network Evolution: Lessons from Electricity Supply History". *Information Economics and Policy* vol. 3 pp. 165-202.

Egyedi, T.M. and Z. Verwater-Lukszo (2005). 'Which standards' characteristics increase system flexibility? Comparing ICT and Batch Processing Infrastructures', *Technology in Society*, 27/3, pp. 347-362.

Fleck, J. (1994). Learning by trying: the implementation of configurational technology, *Research Policy*, 23, pp. 637-652.

Fleck, J. (1988). The Development of Information Integration: Beyond CIM? *Edinburgh PICT Working Paper* No. 9, Edinburgh University.

Geels, F. W. (2007). Transformations of large technical systems: a multilevel analysis of Dutch highway systems (1950-2000), *Science, Technology & Human Values*, 32(2), pp. 123-149.

Grimson, J., W. Grimson, W. Hasselbring (2000): "The SI challenge in health care". *Communications of the ACM* 43 (4), pp. 48-55.

Goodhue, D. L., M.D. Wybo, and L.J. Kirsch (1992), "The impact of data integration on the costs and benefits of information systems", *MIS Quarterly*, 16 (3), pp. 293- 311

Hanseth, O., C. Ciborra, and K. Braa (2001), "The Control Devolution. ERP and the Side Effects of Globalization". *The Data Base for Advances in Information Systems*. Special issue: Critical Analysis of ERP systems: The Macro Level. 32 (4), pp. 34-46.

Hanseth, O. (2001). Gateways - just as important as standards. How the Internet won the "religious war" about standards in Scandinavia. *Knowledge, Technology and Policy,* 14 (3), pp. 71-89.

Hanseth, O., E. Jacucci, M. Grisot, M. Aanestad (2006), "Reflexive Standardization: Side Effects and Complexity in Standard Making". *MIS Quarterly*, 30, pp. 563-581.

Hasselbring W. (2000), "Information Systems Integration", *Communications of the ACM*, 43(4), pp. 32-8.

Heeks, R. (2008), ICT4D 2.0: The Next Phase of Applying ICT for International Development, *IEEE Computer*, 41 (9), pp. 26-33

Hughes, T.P. (1983), *Networks of power. Electrification in Western society 1880 – 1930*. The John Hopkins Univ. Press.

Kallinikos, J. (2004), "Deconstructing information packages: Organizational and behavioural implications of ERP systems". *Information Technology & People,* 17(1), pp. 8-30.

Koch, C. (1997) "Production Management Systems-Bricks or Clay in the Hands of the Social Actors", in: C. Clausen and R. Williams (Eds), *The Social Shaping of Computer-Aided Production Management and Computer-Integrated Manufacture*, COST A4 (Luxembourg, European Commission).

Kumar K and J. van Hillegersberg (2000), "ERP Experiences and Evolution". *Communications of the ACM,* 2000, 43(4), pp. 23-6.

Latour, B. (1987), *Science in Action*. Harvard University Press

Marcus, M.L. (2001), "Viewpoint. Reflections on the systems integration enterprise,'" 2000): *Business Process Management Journal*, 7(3), pp. 171-180.

McNurlin, B. and M. Sprague (2001), *Information Systems Management in Practice*. 5th edition. Prentice Hall.

Mosse, E. (2006), *Understanding the introduction of computer-based health information systems in developing countries: Counter networks, communication practices, and social identity. A case study from Mozambique* PhD thesis, Faculty of Mathematics and Natural Sciences, University of Oslo, Norway.

Orlikowski, WJ. (1992), "The Duality of Technology: Rethinking the Concept of Technology in Organizations". In *Organization Science*, 3(3), pp. 398-427

Orlikowski, WJ. (2002), "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations". *Organization Science*, vol. 11, no. 4, pp. 404–428.

Perrow, C. A. (1984), *Normal Accidents*. Basic Books, New York, 1984.

Pollock, N. and J. Cornford (2004), "ERP systems and the university as a "unique" organisation". *Information Technology & People*, vol. 17 no. 1, pp. 31-52.

Pollock, N., R. Williams, and L. D'Adderio (2007), Global Software and its Provenance: Generification Work in the Production of Organizational Software Packages. *Social Studies of Science*; 37(2); 254-280.

Puri, S., E. Byrne, J.L. Nhampossa and Z. Qureishi (2004), "Contextuality of Participation in IS Design. A Developing Country Perspective". In *Proceedings of the Participatory Design Conference*, Toronto, Canada, 2004, pp. 42-52.

Puri, S. K. and Sahay, S. (2007), "Open Source GIS Applications for Public Health in Developing Countries: Challenges and Approaches". Paper presented at the 9th International Conference on Social Implications of Computers in Developing Countries. (IFIP 9.4), São Paulo, Brazil, 28-30 May 2007.

Puri, S. K. and Sahay, S. (2008), "The Dynamics of Corruption and ICT projects: Case Study from the Public Health System in India", *Proc. International conference on IS* (ICIS), Association for Information systems (AIS).

Raghvendra, R.C. and Sahay, S. (2006), "Computer-based Health Information Systems - Projects for computerization or health management?: Empirical experiences from India". In M. Gascó-Hernandez, F. Equiza-López, M. Acevedo-Ruiz (eds.), *Information Communication Technologies and Human Development: Opportunities and Challenges*. Idea Group Publishing

Rolland, K.H. and E. Monteiro (2006), "The Dynamics Of Integrated Information Systems Implementation: Unintended Consequences Revisited", Submitted manuscript.

Perrow, C. (1984), *Normal Accidents: Living with High-risk Technologies*, Basic Books, New York.

Shidende, N. (2005), *Challenges and approaches to the integration of HIS: Case studies from Tanzania*, Master Thesis, Department of Informatics, University of Oslo. Available at: http://www.duo.uio.no/publ/informatikk/2005/34905/IntegrationHISTanzania.pdf

Silva. L.O. (2002), "Outsourcing as an improvisation: a case study in Latin America" In *Information Society*, 18(2), pp. 129-138.

Singletary, L.A. (2004), "Applications integration: is it always desirable?" In: *Proceedings of the 37th Hawaii International Conference on Systems Sciences*, IEEE.

Spinardi, G., I. Graham, and R. Williams (1997), "EDI in the Scottish Health Service: Inter-organisational Systems and Interorganisational Change", *Journal of Strategic Information Systems*, 6, pp. 251-263.

Stansfield, S, N. Orobaton, D. Lubinski, S.Uggowitzer, H. Mwanyika, (2008), "The Case for a National Health Information System Architecture: A Missing Link to Guiding National Development and Implementation". Paper presented at the "/making:the ehealth>connection*", Bellagio, Italy, July 13 – August 8, 2008.

Summerton, J. (ed.) (1994), *Changing large technical systems*, Westview Press.

Webster, J. (1995), "Networks of Collaboration or Conflict? Electronic Data Interchange and Power in the Supply Chain." *Journal of Strategic Information Systems*, 4(1), pp. 31-42.

Williams R., J Stewart, R Slack (2005), *Social Learning in Technological Innovation: Experimenting with Information and Communication Technologies,* Edward Elgar Publishing.

About the Authors

Sundeep Sahay is professor in information systems at the University of Oslo. He has been deeply involved in the HISP project for a number of years, especially its activities in India. He has published extensively from these experiences

Eric Monteiro is professor in information systems from the Norwegian University of Science and Technology and adjunct professor at the University of Oslo. He is broadly interested in issues of organizational implementation of large-scale integrated information systems.

Margunn Aanestad is adjunct professor in information systems at the University of Oslo. She has worked for many years on different research projects within the domain of health care, both in developing and developed countries.

Journal of the Association for Information Systems

ISSN: 1536-9323