

NETWORKS OF ACTION: SUSTAINABLE HEALTH INFORMATION SYSTEMS ACROSS DEVELOPING COUNTRIES¹

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Abstract

Our paper is motivated by one simple question: Why do so many action research efforts fail to persist over time? We approach this question, the problem of sustainability, building on a perspective on action research identifying the pivotal importance of networks. More precisely, local action research interventions need to be conceptualized and approached as but one element in a larger network of action in order to ensure sustainability. A vital aspect of our perspective is that local interventions depend heavily on the support of similar action research efforts in other locations. This is essential for the necessary processes of learning and experience sharing. We suggest that the scaling (i.e., spreading) of intervention is a prerequisite, not a luxury, for sustainable action research. Empirically, we base our analysis on an ongoing, large-scale action research project within the health care sector (called HISP) in a number of developing countries. HISP provides a fruitful occasion to investigate key criteria for our approach to action research, namely sustainability, scalability, and capacity to be politically relevant to the participants. We contribute to three discourses: (1) models of action research, (2) lessons for health information systems in developing countries, and (3) more generally, IS implementations that are dispersed, large-scale, and have scarce resources.

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Keywords: Action research, networks, sustainability, politics, health information systems

Introduction

The delivery and management of health services to deprived communities and regions in developing countries is a truly complex task. For example, South Africa, with its problem of a rampant HIV/AIDS pandemic, Mozambique, with one of the highest maternal mortalities in the world, and India, with a billion plus population, are all experiencing serious problems of providing their populations with adequate primary health care services. There is a growing recognition by international agencies (notably the World Health Organization—WHO), government authorities, and researchers from different domains including information systems,² development theory,³ and public health,⁴ that improved health information systems (HISs) can significantly contribute to help address health service delivery problems. For example, the total number of infants in a particular area together with the number of those fully immunized give the immunization coverage. By comparing coverage data across a district, across districts within a province, and across provinces within a country, resources and action may be directed toward areas with the poorest coverage.⁵ The develop-

ment of HISs that collect, manage, and analyze such data may, when combined with appropriate practices of information use, significantly contribute to increased immunization coverage and consequently to reduced child mortality. Improved information can place pressure on the government, as in South Africa where the government was reluctant to release and admit data on AIDS-related deaths (Barret and Whiteside 2002).

The WHO Alma Ata declaration worked out in 1978 describes a global vision for “health for all by 2000” through equitable access to basic health services in all countries, called the primary health care approach. Later a key role was delegated to HISs in order to achieve this end through improved allocation of resources and setting of priorities (Lippeveld et al. 2000). A district-based health system to ensure decentralized management and coordination of the health services was advocated as the appropriate level for HIS development (Lippeveld et al. 2000; WHO 1994). It has, however, proved difficult to achieve this vision.

Two broad themes can be identified underlying these rather unsuccessful attempts with HISs in developing countries. The first concerns the challenge to make an information system work, in practice, over time, in a local setting. This involves shaping and adapting the systems to a given context, cultivating local learning processes, and institutionalizing routines of use that persist over time (as well as when the researchers leave and external funding is over). We term this the problem of *sustainability*.⁶ The second challenge, which we term that of scalability, concerns the problem of how to make one, working solution spread to other sites, and be successfully adapted there. Beyond merely the technical aspects of scalability, our concerns lie in how to reproduce and translate the necessary *learning* processes alongside the spreading of artifacts, funding, and people. Important questions here concern who learns what, and through what mechanisms, in order for an IS to spread to new sites and be scaled up.

²See the special issue on health information systems in developing countries in the *Electronic Journal of Information Systems in Developing Countries* (5:2), 2001.

³For example, see the work of Nobel laureate Amartya Sen, who, in his celebrated book *Development as Freedom* (Oxford University Press, 2000), argues for the link between poverty and health, and the need for a stronger informational basis to improve health care and to ensure equity in health services delivery, and thus attack the problem of poverty in developing countries.

⁴See the next section, which reviews literature on health information systems in developing countries.

⁵This information is presented in HISs as health indicators. How these indicators are defined, and by whom, are vital issues in the design and use of HISs as explained in more detail later.

⁶See the proceedings from the IFIP 9.4 (Social Implications of Developing Countries) meeting on held in Cape Town in 2000 (Sahay et al. 2000).

The aim of this paper, then, is to analyze the conditions for *developing sustainable and scalable HISs in developing countries through an action research approach, alongside the scalability and sustainability of the action research process itself*. These issues are explored through a study of HISP (Health Information Systems Program) which currently is ongoing in a number of developing countries including South Africa, Mozambique, India, Tanzania, Ethiopia, Malawi, Mongolia, Cuba, Ethiopia, Nigeria, and China.⁷ We trace the evolution of HISP over a period of 10 years, from its inception in 1994 by researchers from Norway (including one of the authors) and the University of Western Cape and the University of Cape Town to the present. HISP is operating in significantly different stages of implementation in these countries. Thus, in South Africa, HISP has (since 2000) been commissioned by the authorities to do a countrywide implementation, while in Ethiopia and Tanzania the seeds of the project are just being sown. Scale and sustainability have been, and continue to be, central challenges.

To get at our core themes, we draw on analytical notions and insights from distinct schools. We thus employ an eclectic theoretical framework. A key notion that we build upon is that of a *network*. Exactly what is a network when networks, apparently, are everywhere, including network organizations, network society, network of excellence, being networked, and network technology to mention a few? Our use of the term draws on a more selective and confined understanding. To provide the gist of this, our point of departure is the formulation by some action researchers (outside of IS) of a key lesson from earlier action research amounting to a shift of focus "from single organizations and workplaces...to networks" (Engelstad and Gustavsen 1993, p. 209). This proclaimed shift, however, has remained somewhat problematic. There is relatively scattered experience from this type of action research although some (none involving IS) exist (see Engelstad and Gustavsen 1993). There is thus a

need to flesh out in more detail exactly how learning takes place in networks, how experience travels, and how local competence and capacity are cultivated. To this end, we draw upon some elements of actor-network theory (ANT) (Callon 1991; Hanseth and Monteiro 1997; Latour 1986; Walsham 1997) and Castells (1996) in a manner elaborated in the subsequent section.

Our analysis contributes to three different discourses. First, it poses and analyzes key criteria of the sustainability of action research efforts, offering an alternative, *networks of action* model. Second, it feeds into the practical and policy-related debates around working out viable strategies for IS in developing countries in general and primary health care in particular. Third, it is relevant to the understanding of large-scale, infrastructural development of information systems in general, which invariably face related problems of sustainability and scale (Hanseth and Aanestad 2002; Lyytinen 2002).

The next section develops our conceptual framework by combining lessons from IS in developing countries and action research with analytical insights from ANT and Castells. The section on the research approach describes our primary goals, the structure, the process, and the researchers' involvement. A section devoted to the empirical description of HISP is then presented, followed by a section discussing and analyzing the three issues of sustainable interventions, the politics of networks, and revisiting models of action research in IS in light of our perspective. Concluding remarks are offered.

Conceptual Framework

This section develops our conceptual framework, leading up to a perspective on action research we have termed *networks of action*. To arrive at this, we first need to review relevant experiences from IS in developing countries, particularly within health, and lessons from action research projects. This enables us to explain where and how the analytical imports from ANT and Castells fit.

⁷For more information on specific programs, see <http://hisp.org> and <http://www.hispindia.org>.

HIS in Developing Countries: The Context and Arena for HISP

The grand vision in the late 1970s by the WHO of efficient and equal delivery of primary health care (PHC) has proved difficult to realize. Problems related to scarce resources and their effective allocation and use have led to a strong focus on strengthening HIS (de Kadt 1989; Sandford et al. 1992). The WHO has since promoted a decentralized approach based on the notion of a district as a self-contained geographical entity, to better integrate the multiple health programs, including their HISs, that typically exist (WHO 1994). Currently, most developing countries have routine (paper-based) HISs in place to collect and report data, but these are often inadequate to effectively support health care as data is merely collected to be fed upward (Lippeveld et al. 2000). In contrast, an action-led HIS focuses on collecting data that inform local decision making, before reporting upward (Sandford et al. 1992). Too often, attempts to computerize these HISs have only produced pilot systems or systems that fail to exist after donor-based funding⁸ has ceased (Heeks and Baark 1998). For the purposes of this paper, it is important to review in more detail literature discussing this lack of sustainability.

One example comes from the Kisarawe district in Tanzania where an action-led approach to information was attempted and demonstrated glaring inequities between different areas within the district. However, efforts to redistribute resources by transferring staff were thwarted as health workers did not want to move as no resources were allocated for commuting and there was an absence of political will to support change. Sandford et al. (1994) conclude that interventions limited to HIS development alone were not sustain-

⁸Donor-based funding is funding provided by external countries, development agencies, and non-governmental organizations that sponsor a variety of projects in developing countries. An important aspect, for our purposes, is that this funding normally has quite fixed time-spans, limiting their ability to be sustainable as discussed further below. Some developing countries, such as Mozambique, have a majority of projects within health that are donor initiated.

able in the absence of a larger health reform establishing incentives to rectify performance failings. Donor initiated projects, typically in limited time periods (of the aid package) in selected pilot sites with inadequate focus on local expertise, similarly leave a trail of unused, thus unsustainable, pilot projects (Heeks and Baark 1998; Littlejohns et al. 2003; Sahay and Walsham 1997).

Many issues about IS in developing countries are common across all applications and areas (for a review of the many ways organizational and social issues are inadequately addressed, see Avgerou and Walsham 2000; Heeks and Baark 1998). Yet, there is one aspect of our particular area of interest, the health care sector, which gives rise to a relatively unique demand on the HISs. This is the demand, intimately linked with the political visions of promoting equity in access to health services, that the local routines of managing information be replicated to all corners of a district, to all districts in a province, and to all provinces in a country. This problem, which could be termed *all or nothing*, implies that the interventions embedded in the successful, local use of a HIS have to spread. For this type of HIS, local success is not sufficient to be sustainable; it also has to have scale. Several authors, including Simwanza and Church (2001) reporting on their work in Zambia, point out how, despite local successes, the efforts failed to scale as "it has not been possible to devise a mechanism to transfer skills developed in these provinces to other areas of the country" (p. 228).

In what follows, we pursue issues of sustainability and scaling of interventions drawing upon related experiences and insights from the literature on action research in IS. Elements of the action research efforts in Scandinavia have been particularly attentive to these issues, thus warranting special scrutiny.

Lessons from Scandinavian Action Research in Information Systems

For our purposes, there are two aspects of Scandinavian-based action research that are

relevant to our analysis of HISP. These two aspects simultaneously serve to position us in relation to Anglo-American action research: the political agenda and the focus on sustainability.

From its start in the 1970s, the Scandinavian-based action research had an explicit, political agenda of boosting the capacity of the workers and the unions in their negotiations with management. This was motivated by a perceived threat to job security from technology. The strategy at the local level, illustrated by the Iron and Metal Workers Union (NJMF) project, was to develop knowledge about the technology in question and to actively propose alternatives to those of the management (Nygaard 1979). This enabled the unions to negotiate settlements and institutional arrangements ensuring a certain influence over the process. A similar sense of political agenda is embedded in the HISP effort.

The second issue, continuing on from this, was how to ensure the sustainability of these capabilities. This challenge was emphasized by the lack of sustainability of apparently successful projects. The UTOPIA project is central here (Bjerknes et al. 1987). This project, involving the Nordic Graphical Union and several Scandinavian research institutions, was established as a response to the threat represented by new technologies to graphical workers. Their approach was to develop alternative technologies controlled by the graphical workers' skills and perspectives. They set up a laboratory where skilled graphical workers from the newspaper industry and researchers developed paper and computer based prototypes. Despite its important lessons about mock-up prototypes and future workshops (Greenbaum and Kyng 1991), the prototype failed to be sustainable. The key reason, which brings us right back to our analysis of HISP, is that UTOPIA failed to forge alliances with a surrounding network of journalists and other professional groups (Bjerknes et al. 1987). Although the earlier NJMF project succeeded in enrolling actors locally in selected workplaces and triggering national legislation, NJMF in a similar way failed to establish a network of workplaces pursuing similar strategies.

These experiences from IS action research in Scandinavia identify the key criteria of a political agenda and sustainability shared by HISP. There was, however, a relative failure to actually achieve sustainability.

Networks of Action

In Scandinavian-based action research *outside* of IS, sustainability has been addressed. The key observation from this body of action research is the recognition of *the need to situate the action within networks rather than on singular units*⁹ (Elden and Chisholm 1993). This shift has emerged more out of necessity than by design, through the recognition of the relative failure to institutionalize and make changes sustainable. This, the argument goes, is because local interventions *need* to be part of a larger network to be robust. In short, scalability is a prerequisite—not a luxury—for sustainability of local action. Establishing networks creates opportunities for sharing of experience, knowledge, technology, and value between the various nodes of the experience:

The main argument for [establishing networks of action research projects] was not so much to make each group reach the level of "critical mass"—which [a few] organizations will seldom do—as to *make them learn to work together...* the idea was to help broad networks grow forth. (Gustavsen 2001, p. 20, emphasis added)

Hence, the emphasis on scale through a focus on networks is *not* so much about size as facilitating the necessary learning processes for sustainability (Elden and Chisholm 1993, p. 293). Despite articulating this lack of sustainability, there are, more than 10 years later, only a limited (none within IS) number of action research projects adhering to this approach (Engelstad and Gustavsen 1993; Green-

⁹The pivotal special issue on action research by *Human Relations* (46:2; February 1993) makes this point.

wood and Levin 2000). There is thus a need to tease out in more detail exactly how these learning processes in and through networks take place.

Building on this articulation of the role of networks in action research made a decade ago, we supplement our discussion with recent conceptualizations of networks. Actor-network theory (ANT) is a vehicle well suited for portraying the dynamics of the circulation and appropriation of artifacts, routines, people, and guidelines that make up the concrete ingredients of HISP (Callon 1991; Hanseth and Monteiro 1997; Latour 1986; Walsham 1997). A compact way of conveying the essential idea of translation is to contrast it with the notion of diffusion. Diffusion, in the context of developing countries, is related to the theme of technology transfer (Avgerou and Walsham 2000; Walsham and Sahay 1999)—i.e., the spread (or transfer) of technology and routines from one site to another. In contrast, ANT insists that diffusion “of anything—claims, orders, artefacts, goods—is in the hands of people...modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it” (Latour 1986, p. 267).

Translation takes place both vertically through local appropriation and horizontally as artefacts and routines spread to new sites. The translations that go into local appropriation correspond closely to the gradual institutionalization or routinization of the IS as it seeps into the fabric of everyday practice (Orlikowski and Barley 2001). The horizontal translations—or as Czarniawska (2002) phrases it, “how ideas travel”—deal with mimetic imitation (as opposed to mechanical copying; it is never the “same” solution) of experience as a selective appropriation to the new context of use.

In addition to the notion of translation, we draw on the ANT term of alignment (Callon 1991). Alignment is a relative measure of the extent to which the agendas and interests inscribing into the practices, institutions, and strategies of the network pull in the same direction, and serve the same purpose. A high degree of alignment is accordingly a characteristic for robust, enduring networks. The notion of (lack of) alignment is simultaneously a timely reminder that agendas and

interests may be diverging, in opposition, or competing. The political economy of competing agendas is played out very much as the issue of whose network will dominate (see also Bowker and Star 1999). Castells’ (1996) analysis of the constitution, logic, and dynamics of networks is relevant here. Castells’ work helps us pose questions such as whose networks are these, and who gets included or marginalized by a certain configuration and dynamic of the network? Our interest in Castells is more narrowly warranted by the way he identifies opposition to networks known as counter-networks. Castells (2000, p. 5) brings up, but never really develops, a notion of counter-network that emphasizes this point:

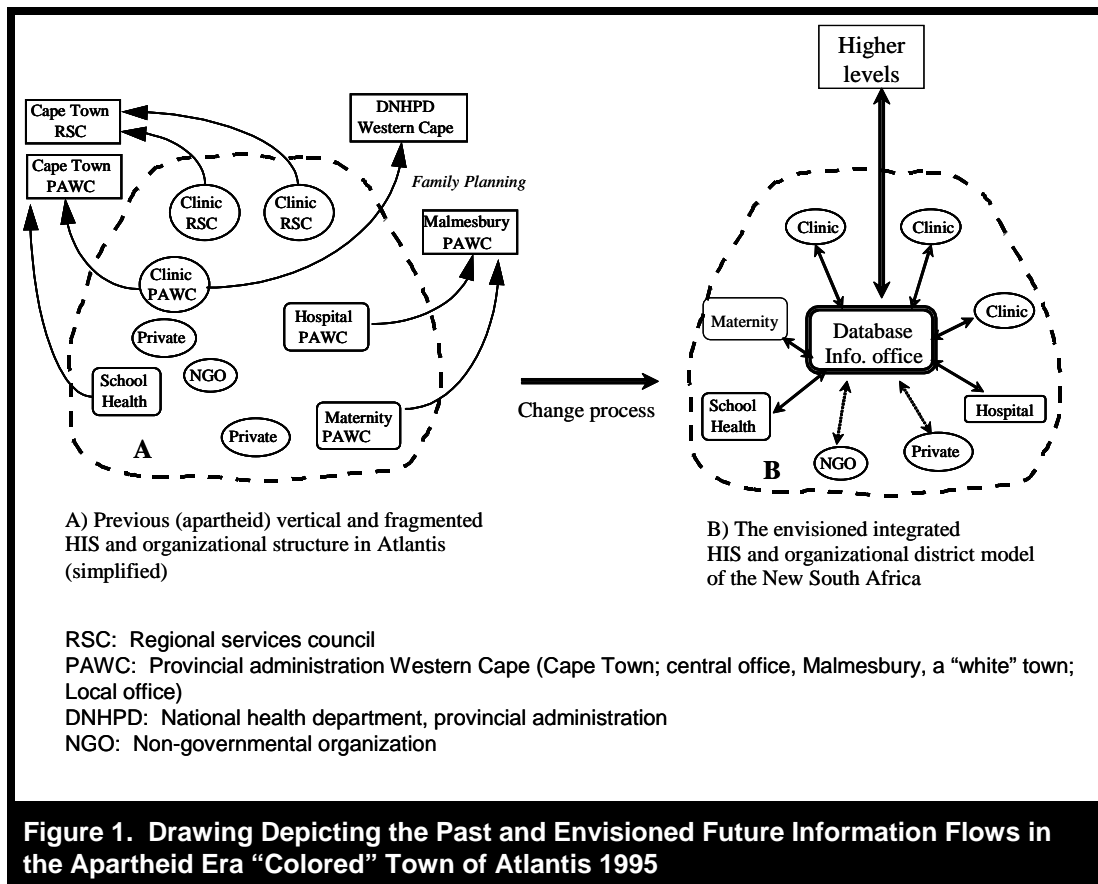
Increasingly, counter-domination operates through networks as well, as in the case of the environmental movement, or of counter-cultural movement, or of human rights organizations, linking up the local and global through the network.

The political economy of HISP is that HISP represents a marginal, alternative, and, at times, opposing network relative to the significantly larger and dominating network through the WHO, various donor agencies, the World Bank, national health authorities, and large corporations selling hardware and software.

In sum, the notion of networks of action is intended to capture the dynamics of translating, aligning heterogeneous networks of routines, technology, and learning within politically contested terrains of opposing projects and ideologies in an effort to promote sustainable, replicable changes.

The HISP Action Research Approach

To account for the HISP action research approach, we lean on the characterization of action research by Baskerville and Wood-Harper (1998). We discuss the primary goals, structure, process, and researcher involvement in HISP.



Primary Goals

The primary goal of the HISP research is to *design, implement, and sustain HIS following a participatory approach to support local management of health care delivery and information flows in selected health facilities, districts, and provinces, and its further spread within and across developing countries.* This formulation captures the way our approach reiterates the articulation from former Scandinavian-based action research of sustainability and scalability as key criteria in action research. Figure 1 illustrates the challenge from South Africa: to change from the fragmented and centrally governed health services inherited from apartheid, to an envisioned situation with integrated and to some extent locally governed health services of the new South Africa. This figure, used in a number of training manuals and

guidelines, represents well the political agenda of HISP.

The primary goal encompasses three key issues: HIS design, development, and implementation, including improved use of information; organizational and human resources development; and developing theoretical and practical knowledge about the challenges of implementing HIS in developing countries, with a focus on issues of scale and sustainability.

At an abstract level, these goals are largely shared. In practice, however, it is highly contested. Decentralization includes development of at least some budgetary control and thus (potentially) undermines the power of the higher levels. Similarly, integration of the strong vertical health programs is controversial as it tilts the power base

of organizational structures. Thus, there are ongoing negotiations with health authorities about the nature and extent of involvement of HISP.

Structure

HISP can be conceptualized as a relatively loose network structure comprising at the first (horizontal) level different countries, and at the second (vertical) level various institutions within these countries. Three structural instruments controlled by HISP are important in spreading and consolidating the network: (1) the software being developed by the South African team based at the University of the Western Cape (UWC) and spread throughout the network, (2) the Ph.D. program run from the University of Oslo (UiO), and (3) the two integrated master's programs in public health and informatics being developed at University Eduardo Mondlane (UEM), Mozambique, in collaboration with UiO and funded by the Norwegian Development Agency (NORAD). These master's courses are also admitting students from other HISP countries. Norway, South Africa, and Mozambique represent the hubs in the network. Together with Ethiopia and Tanzania, they could be called *primary nodes* as the activities are based on contractual agreements with national universities and the health authorities. Malawi, Cuba, Mongolia, and Nigeria, where there are no similar university agreements and no students (apart from Malawi), can be described as *secondary nodes*.

While UWC constitutes the center of a large network of action research, software and systems development, and countrywide implementation in South Africa, and its spread to other countries on a professionally based *ad hoc* basis (such as Malawi and Nigeria), the UiO is initiating and coordinating the larger international action research network, including generating funding, supervising doctoral and master's research students, and conducting different educational programs.¹⁰ The

¹⁰The Ph.D. program run by UiO is made possible through a flexible Norwegian scheme providing basic funding for students from developing countries. The

flexible prototyping capability of the free and open software developed in South Africa, which is adaptable to most developing-country health system contexts, is a crucial tool for participatory HIS design and development in cooperation with health professionals in all HISP countries.

Within the countries, the vertical networks are comprised of various institutions and government agencies, playing different roles. Each primary node country has a HISP team constituted differently including faculty, full-time project staff, doctoral and master's students, software companies, and health department staff. While funding for implementation comes from international donors and local health authorities, funding for research activities in different countries, scholarships for doctoral and master's students, and funding for intercountry linkage building comes from different sources, although it is primarily supported by the Norwegian authorities. Table 1 summarizes the key institutions involved in the different countries, their responsibilities, the constitution of the HISP team, funding sources, and a time-line of the activities. The table thus emphasizes the extreme diversity within the network.

In addition, there are politically motivated, fluctuating structures. To illustrate, a recent political upheaval in Cuba where the health minister lost his job meant that existing permissions for HISP were revoked. In India, the continuance of HISP is largely contingent on the current political party being returned to power in the next elections scheduled for December 2004.

master's programs in Mozambique together with this Ph.D. program represent the most important structural network-building instruments controlled by UiO. To illustrate, two Tanzanians and one or two Mozambicans admitted to the master's program in Mozambique 2001 and graduated in 2003 are joining the Ph.D. program in 2004. The two Tanzanians, staff from the University of Dar es Salaam (UDSM), have been instrumental in establishing HISP agreements with UDSM and between UDSM and the health authorities in Tanzania. Based on these positive results, initial funding for extending the master's program to Tanzania and UDSM, out of Mozambique as a "South-South" venture is secured from NORAD for 2005-06, and similarly to Malawi.

Table 1. Institutional Basis, the Team Organization, and Funding of the HISP Network

Name of Country and Partner	Local Institutions and Responsibilities	HISP Team Constitution	Funding Structure ^a	Involved Since
South Africa: School of Public Health, University of the Western Cape (UWC)	UWC: Master's course and short courses, Ph.D.s, research. UWC/HISP: national roll-out, DHIS software development. National and provincial health authority: partner in implementation and training.	HISP constituted as not-for-profit organization within UWC; 10 members, 2 Ph.D. students.	NORAD (1995-1998), EQUITY/ USAID (1998-2003); health authority (1999 onward), NUFU (1999-2006), Norwegian research council (2003-2005).	1994
Norway: Department of Informatics University of Oslo (UiO)	UiO: Coordinating HISP, Ph.D. program and supervision, master's course, support master's course at UEM.	3 staff coordinate HISP, additional 3 take part in Ph.D. supervision. 9 Ph.D.s and approximately 10 master's students.	NUFU (1999-2006) research fund in South Africa (2003-2005); 9 Ph.D. scholarships; NORAD master's courses (2001-2005).	1993
Mozambique: University Eduardo Mondlane (UEM) health and informatics	UEM: Research, master's courses, training and implementation in 3 provinces. Ministry of Health: full HISP partner.	HISP team: 5 Ph.D. students, 2 Ministry of Health staff, and 1 UEM staff. 2 master's courses in health and IS.	NUFU (1999-2006) 2 UEM master's courses (2001-2005), 5 (of 9) Ph.D.s.	1998
India: Administrative School of India (ASCI), Indian Institute of Management, Bangalore (IIMB)	ASCI/HISP Andhra Pradesh: research, training, implementing, contract with state department of health. IIMB/HISP same in Karnataka, one district.	Andhra Pradesh: 10 trainers and coordinators. Karnataka: 1 Ph.D. student, 1 staff, 1 software responsible. 5 UiO master's students.	Andhra Pradesh government funds implementation. NUFU (2002-2005) 1 Ph.D. (of 9).	2000
Tanzania: University of Dar es Saalam (UDSM) health and informatics	UDSM: team conducts training and supports pilot in 2 districts.	1 UDSM staff (health), 1 Ph.D. and 2 master's students, 2 master's candidates.	1 (of 9) Ph.D., 4 master's students (2 graduated). NUFU (2003-2005).	2001
Cuba	Ministry of Health/office of statistics: implementation team.	2 Ministry of Health staff, 3 Norwegian master's students.	80 PCs donated.	2002
Mongolia	Ministry of Health/office of statistics.	1 Ministry of Health staff.	NUFU (2002-2003).	2002
Ethiopia: Addis Ababa University (ABU) informatics	ABU: team of Ph.D.s and master's initiating research in 4 regions	3 Ph.D.s, 5 master's students.	3 Ph.D.s (of 9), 5 master's students.	2002
Malawi: Medical College, University of Malawi (UM)	Ministry of Health: Implementing DHIS. UM: courses for health staff and master's students.	Health staff, HISP South African expatriate advisor on HISP to Ministry of Health.	Dutch AID, NORAD, USAID.	2000

^aThe Norwegian Council of Universities' Committee for Development Research and Education (NUFU) has provided a total of 3.6 million NOK (Norwegian Kroners; 7 NOK is approximately \$1 US) from 1999 through 2001 (1.2 million annually) and 8.5 million NOK from 2002 through 2006 (1.7 million annually), for a total of 10.4 million over 7 years. In addition, a Norwegian research council grant for South Africa of 1.35 million NOK (0.45 million annually from 2003 through 2005) leads to a grand total of 11.75 million NOK (approximately \$1.5 million US). In addition, there are nine UiO quota Ph.D. scholarships amounting to 2.8 million NOK, and NORAD supports a master's student, contributing partly to research.

Process

Baskerville and Wood-Harper (1998) describe action research processes to be iterative, reflective, or linear. This classification, however, inadequately describes the processes involved in HISP. It does not take into account the long term character of the development needs of the poorest countries in the world, where HISP is operating. Rather than clear stages or phases, HISP is characterized by a multiplicity and simultaneity of ongoing processes which take on different forms at various stages, and there is rarely ever a clear start or end. Table 2 summarizes the key processes. To illustrate, in 2003, the Ministry of Health in Mozambique released the plan for countrywide implementation of the new HIS, which is based on the software being developed by HISP, to all districts, hospitals, and health centers. HISP is committed to support this implementation plan, which starts in 2004 (HISP's eleventh year of existence), and extends into 2010. Development in Africa requires long-term commitment. Development and implementation in the different countries are typically linked to time-bound funding and are defined as subprojects. When the specifically funded rollout project in South Africa ended in 2003, additional functionality for improving the use of information for local management was identified as new subprojects within particular districts (with distinct funding). Similarly, in India, where the authorities have provided piecemeal funding over the last two years, a district database is being adapted and implemented in all 23 districts in the state of Andhra Pradesh.

Role of the Researchers

The role of the researchers in HISP cannot be understood in simplistic terms of whether or not the researcher is involved, or the project is driven by the researcher or client needs. It needs to be analyzed in a more fine-grained manner because of two conditions of the problem domain.

The first concerns the multiplicity of the research efforts, implying that the role of the researcher has

to mirror the variety in the type of actions. Several master's and doctoral students contribute to the HISP research efforts, in an action research mode contributing to the HISP implementation efforts while simultaneously working on their respective theses. Thus, researchers do not have singular roles in HISP, but engage in distinct networks (supervision, training, systems design, mobilizing support, generating funding) yielding "a number of different forms and levels of participation" (Gustavsen 2001, p. 20).

The second condition is directly related to the political nature of the health sector. The researchers in HISP have to be reasonably aligned with the official mandate of the health department.

The delivery of primary health care services is a task mandated by the official health authorities, so a minimum of support is required—or needs to be mobilized—to legitimize any changes. Simultaneously, it is important for the research team to be reasonably independent. There is a danger of losing this independence given the political nature of the health arena where multiple agencies operate and try to enroll (and also throw out) other actors through the power of money and political clout.

In HISP, the processes of data collection and analysis are inextricably interlinked. Because of the very involved nature of research where the HISP team members are literally living on site with the health staff and are continuously engaged in various activities, it is impossible to give quantitative details as in traditional research of the number of interviews or repeat interviews conducted. Also, there is no singular and well-defined process of analysis. For the purpose of writing this paper, a core group of three researchers were involved in synthesizing the many years of practical and theoretical experiences, drawing extensively upon the analysis and understandings of a whole network of students, researchers, and practitioners. Earlier drafts of the paper were circulated among HISP members and used in courses and seminars for Ph.D. and master's students and others over a two-year period. Our interpretations and observations have accordingly been subject to

Table 2. The Nature of HISP Process Around HIS Design, Training, and Support

The Process	Nature and Focus of Action
HIS design, development, and enhancement	<ul style="list-style-type: none"> • Software development; the DHIS database application • Standardization: Hierarchy of standards design principle for modularization • Participatory processes • DHIS development at two levels: global (South Africa) and local (individual countries)
Education and training	<ul style="list-style-type: none"> • Ph.D. program based at UiO; students from HISP countries • Building integrated master's programs in informatics and public health in Mozambique, South Africa, Malawi, and Tanzania • Developing educational schemes to support national HIS development • Strengthening links between research-education-teaching, Ph.D. and master's students
Garnering political and financial support	<ul style="list-style-type: none"> • Gaining access to initiate HISP in different countries, negotiating a point of entry • Within countries, building inter-institutional linkages and obtain funding • With scaling, increased challenge to gain funding to sustain HISP • Need to develop HISP champions

a certain validation. The oral and written feedback has been varied. Some concerned minor, factual details. Others raised more principal concerns. To illustrate this latter type of feedback and the way it has influenced our interpretations, the central role of the network-building capacity of master's and Ph.D. programs is a direct and recent (2004) result of ongoing discussions with HISP members. Similarly, the categorization into primary and secondary nodes has fluctuated throughout the process of writing this paper. Finally, in earlier versions of the paper, the coincidental element occupied a too-dominating place. With the current scale of HISP, and pointed out by fellow HISP members, we have become more aware of the conscious and structural elements of the network dynamics.

Beyond fellow HISP members, a crucial type of validation of our interpretations is the reaction and perception of practitioners (including end-users, health bureaucrats, policy makers) (Klein and Myers 1999). Our narrative is admittedly biased toward the interventions themselves more than their perceived effect. Implicitly, it is clear that without a reasonably favorable reaction, sustain-

ability would never be an issue. More directly, the achievements of HISP, particularly in South Africa, are increasingly being acknowledged by the practitioners. To illustrate, in October 2003, the RHINO (Routine Health Information) network held a workshop in South Africa, gathering participants from a number of countries and international agencies, and assessed HISP favorably.

The HISP Network

In this section, the HISP network is described in varying levels of detail in the different countries. South Africa, Mozambique, and India are described in some detail, whereas the other nodes are summarized. Given the large mass of empirical experiences with which we deal, the presentation is structured for every country around the three key processes: (1) gaining political support, (2) HIS development, and (3) training and education. Table 3 provides a condensed summary of the health sector contexts in the different countries relevant to the challenges of scale and sustainability. Table 4 presents a summary of key events with a time-line in the different countries.

Table 3. Health Sector Context in the Countries Within the HISP Network		
Country	Characteristics of Country and Health Sector Context	
South Africa Population: 43 million HDI rank: 115 GNP/cap.: 3.160 sq. km.: 1.2 million	<ul style="list-style-type: none"> • Legacy of apartheid: fragmentation and inequitable health care system • Still 60% of total health expenditures (private) for only 20% of population • Still poor development of public health in historically disadvantaged areas • Nine provinces being revised 	<ul style="list-style-type: none"> • Rampant HIV/AIDS pandemic combined with tuberculosis biggest health problem • HISP ongoing in all districts (computers) and health facilities • Stronger industrial, finance sector than the rest of Africa south of Sahara combined
Mozambique* Population: 18 million HDI rank: 157 GNP/cap.: 230 sq. km.: 0.8 million	<ul style="list-style-type: none"> • Long period of war ended in 1992 • Very poor country and health system • Less than 400 doctors in total • Very poor general infrastructure • Rampant HIV/AIDS pandemic 	<ul style="list-style-type: none"> • High tuberculosis and malaria • Very high maternal, infant mortality • Nine provinces and 128 districts • Strongly donor dependent economy
India Population : 1 billion+ HDI rank: 115 GNP/cap.: 450 sq. km.: 3.2 million	Andhra Pradesh state: <ul style="list-style-type: none"> • 75 million population, 23 districts, and 1300 PHC • Each district caters to about 2 million to 4 million people on average • Each PHC is managed by a doctor and caters to about 40,000 to 60,000 people 	State agenda: IT for poverty reduction <ul style="list-style-type: none"> • Health sector extremely hierarchical, centralized, and bureaucratic • Poor governance
Malawi* Population: 18 million HDI rank: 151 GNP/cap.: 190 sq. km.: 0.12 million	Tanzania* Population: 33 million HDI rank: 14740 GNP/cap.: 240 sq. km.: 0.95 million	Ethiopia* Population: 65 million HDI rank: 158 GNP/cap.: 100 sq. km.: 1.1 million
Mongolia Population: 2.3 million HDI rank: 116 GNP/cap.: 350 sq. km.: 1.5 million	Cuba Population: 11 million (no UN statistics) Very good health sq. km.: 0.15 million	

*Mozambique, Malawi, Tanzania, and Ethiopia are among the 22 poorest countries in the world, HDI: Human Development Index (statistics from UNDP and World Bank 2001).

Table 4. Time-Line of Key Implementation Events in the HISP Network

Country	Summary of Key Events			
South Africa	1994 1995 1996 1997 1998	<ul style="list-style-type: none"> • First democratic election • HISP initiated as a RDP project • Achieve NORAD funding for 1996-1998 • Established in three pilot districts in Western Cape • First essential data set tested and then implemented in Western Cape • Essential data set implemented in Eastern Cape • First prototype of DHIS in Western Cape, cover whole province during the year 	1999 2000 2003	<ul style="list-style-type: none"> • DHIS including 1998 data implemented in all districts in Eastern Cape end of 1998 • New funding from USAID and NUFU • National endorses HISP for national rollout • National standards for health data agreed, processes in all provinces • EQUITY funds national rollout 1999-2003
Mozambique	1999 2000 2001	<ul style="list-style-type: none"> • HISP initiated and conducts survey • Five Ph.D. students enrolled • Pilot in Northern province starts • Flood in the South • Master's in Informatics and health 	2002 2003	<ul style="list-style-type: none"> • Training and initiatives in three provinces • Full multi-language DHIS • DHIS implemented in many districts in three provinces
India	1999 2000 2001 2002	<ul style="list-style-type: none"> • First contact with Andhra Pradesh officials • Situation analysis in two states (Karnataka and Andhra Pradesh) • Presentation for Andhra Pradesh officials • EDS development • DHIS prototyping in 9 PHC centers 	2002 2003	<ul style="list-style-type: none"> • Endorsed by health authorities, 10 trainers hired • Working to integrate with patient record project (FHMIS)
Malawi	1999 2000 2001 2002	<ul style="list-style-type: none"> • HIS project funded by Dutch aid • UWC training of MoH people • DHIS adapted, pilot in 2 districts • Implementation in all districts and hospitals 	2003	<ul style="list-style-type: none"> • University contacts and course from UEM • HISP South Africa contract to support funded by USAID

South Africa: Where HISP Was Born (1994–Ongoing)

The Process of Garnering Political and Financial Support

As part of South Africa's Reconstruction and Development Program (ANC 1994b), strategic

management teams were established to develop plans for the reconstruction of the health sector in all provinces, including the creation of a unified HIS (ANC 1994a). HISP was initiated through this initiative when the HIS subcommittee for the Western Cape province proposed a pilot project to develop a district-based HIS in their final report early in 1995. Two of the founding members of

HISP were part of this committee and the proposal was based on early action research in two “colored” townships created by apartheid through forced removal in the 1970s (Braa et al. 1997). The proposal received funding from the Norwegian Agency for Development Co-operation (NORAD) for the period 1996 through 1998. Based at the two Cape Town universities, HISP was established in three health districts with one full-time district facilitator in each district and a project coordinator. The process of garnering political and financial support for HISP and the development of the wider HIS has been an intense process of action, achievements on the ground, tinkering, and building of alliances within the turbulent world of post-apartheid health sector reform (Braa and Hedberg 2002).

Given the fragmented and chaotic state of the HISs in post-apartheid South Africa, the key focus has been standardization through the two inter-linked processes of developing *essential datasets* and the developing of the *district health information software (DHIS)* application to support their implementation. An essential dataset (EDS) represents a set of those minimum data elements that are needed for the calculation of priority indicators.¹¹ The first stumbling block was that the districts where HISP were based had an interim and transitional character, whereas the larger Cape metropol made up the basic formal administrative unit, which had to be targeted. Using action research in the pilot studies as a point of departure, after about nine months of intensive negotiations driven by local managers in collaboration with the HISP team, the first EDS was implemented in all local government health facilities in the Cape metropol, and later in the whole of Western Cape (early 1998). The rapid success of the EDS in Western Cape was significantly enhanced by the prototyping of the DHIS application, which was used to capture the data and provide

management and health workers at all levels with easy access to the data for analysis using their own or a nearby computer and feedback reports every month.

The standardization process in Western Cape fed into and interacted with similar processes in the neighboring Eastern Cape province, where, as a happy coincidence for HISP, they experienced serious problems in developing their own database application to support the implementation of their EDS. Since DHIS was up and running in the Western Cape, the health authorities in Eastern Cape, supported by the EQUITY project,¹² asked HISP to adapt and implement the software in their province. Through the spread to a second province, HISP became an important actor in the national standardization and HIS processes, and, as important, EQUITY secured funding from late 1998 to end of 2003 (for an account of the Eastern Cape experience, see Wilson et al. 2001; Shaw 2002). The relative success in two provinces led other provinces to initiate similar processes and, from 2000, endorsed as a national rollout scheme supported by EQUITY.

The Process of HIS Development, Standardization, and Software Prototyping

The fragmented reporting systems and the participative action research in HISP were clearly demonstrated during a workshop in the industrial “colored” town of Atlantis, one of the HISP pilot districts, when the nearly 100 data collection forms in pre-HISP use were glued to brown paper and hung on the walls, and the health workers challenged the authorities about their relevance (Braa et al. 1997). This workshop illustrates the first phase of developing an EDS that was supported by participatory processes using questionnaires, workshops, and training sessions at both

¹¹The focus on indicators in contrast to “raw” data is a key vehicle in HISP. Indicators defined and used to monitor priority health targets, such as infant immunization *coverage* and cure *rate* for tuberculosis patients, are more effective than only providing numbers of vaccines given and patients cured.

¹²EQUITY is a South African Ministry of Health project financed by the United States Agency for International Development (USAID) and a supporter of HISP. Key proponents behind the EQUITY project also were active in the Malawi case presented later.

the district and province levels. A decisive moment was when the action was scaled up to include first one then two provinces. The two provinces, despite following similar approaches, had arrived at different EDSs, emphasizing the need to provide autonomy to the provinces (to define their EDS) yet have a common national basis for comparison. A survey of the data standards in use in all provinces conducted by two HISP team members in 1998 was presented at a national HIS committee meeting later in the year and was used as a point of departure for developing a first national standard EDS in 2000 (45 elements, about 40 percent of them different from the first EDS in Western Cape). Consensus on a national EDS was enabled by applying the principle of a hierarchy of standards, providing each level with the freedom to define its own standards as long as they adhered to the standards of the level above.¹³ While this horizontal diffusion of the standardization approach resulted in establishing a national EDS, the vertical processes have enabled the individual provinces to extend and develop their own datasets. Currently all provinces are managing approximately 600 to 800 data elements while there are 60 to 70 elements in the national EDS.

Alongside defining the first EDS, attempts were made to develop the first version of the *DHIS software*. A professional software development team was established and, after some early prototypes, a first version of the DHIS software was implemented in Western Cape in 1998. As health staff at different levels started to use it (first in the pilot districts) to capture and analyze monthly data, they provided suggestions for improvements. This on-site, participatory prototyping led to rapid cycles with new builds on a weekly or even daily basis. As the use of the application increased, the cycles slowed down to cater for stability and more systematic versioning. The prototyping approach was then changed to let advanced users and districts test out new versions and functionality before releasing them.

¹³This principle corresponds to inheritance mechanisms as found in object-oriented design and programming.

The Process of Education and Training

The prototyping cycles described above have been strongly supported by ongoing training and education processes. The formal HISP training established a home base at the UWC with courses as part of their master's in public health programs. Since 1997, nearly 2000 health workers have taken part in these courses. A key feature of the training has been the use of local and real data and the ensuing action learning cycle includes the analysis of this data, and its application, by developing a situation analysis and corresponding plan of action for a district. A HISP training manual has been created which is continuously updated and also circulated to other HISP nodes who adapt it to their needs. Ten full-time trainers, mostly professional nurses, are engaged in the training in the provinces.

Mozambique: The First Node in the International Network (1998–Ongoing)

The Process of Garnering Political and Financial Support

HISP started officially in January 1999, funded by the Norwegian Council of Universities' Committee for Development Research and Education (NUFU), with University Eduardo Mondlane (UEM) and MISAU (Ministry of Health) as partners. The aim was to develop a HIS in three pilot districts. The pre-HISP database application currently used in the HIS at provincial and national levels is acknowledged by MISAU to be obsolete and needs replacing. However, in contrast to the situation in South Africa, where the provinces are free to go ahead with their own development, in Mozambique the provinces are governed from the center, and to change the software of the national HIS would require a decision at the governmental level. Despite MISAU's contractual commitment to take part in HISP and strong participation from the people in charge of HIS within MISAU, they did not back it up with strong official support. One important reason for this reluctance has been that MISAU and donors alike have focused on the

provinces in order to establish a first level of capacity, good governance, and reliable HIS. Since HISP has been perceived as a research project exploring ways to develop capacity and HIS at the district level, HISP has not been involved when MISAU and the donors have prioritized quick fixes in the provinces. Another major reason for the difficulties experienced has been the multitude of uncoordinated, and to some extent competing, donors and agencies with their different approaches to information technology systems, which is typical for a donor-dependent economy. To illustrate, during the period 2001 through 2003, HISP was seen to be in competition with the efforts of a large international company with political and initial economical support that was developing a "master plan" for computerization of the entire health sector. This plan had a budgeted cost of \$55 million (US), many times the resources of HISP. It proved to be impossible to get donor support for such an expensive project, but very few in MISAU wanted to oppose it in case it got through, thus causing a dead-lock for about two years. Nevertheless, in late 2003, after years of negotiations back and forth, MISAU made a principal decision to base the future HIS on the DHIS software, and is thus counting on support from HISP.

The Process of IS Development

An initial survey of information technology diffusion and use (with a focus on health) in the three provinces where the pilot districts were located was conducted and provided the basis for initiating the HISP research (see Braa et al. 2001). The key problems identified were related to poor reporting and data management systems at district and provincial levels, no feedback of information, and no involvement of the district level. Another problem was that many data elements, including immunization, are aggregated to district totals, making the information impossible to use for local decision making at the health facilities and at the district level. The strategy applied to address these problems was to develop pilot systems based on existing data standards in three districts in three different provinces. It soon became clear, however, that development at the district level needs

to be interlinked with action and capacity development at the province level since this level is both the receiver of the data and responsible for supporting the districts. Data from only one out of the 12 to 18 districts in a province is not very useful for the provincial administration. To become relevant, the whole province need to be included. In order to demonstrate the advantage of a province-wide approach, data from the entire country were transferred from the old system to DHIS and a prototype national database with full provincial data sets was developed and presented to the MISAU and the provinces. The five doctoral students, who have been the key drivers of the HISP implementation, have jointly translated the DHIS to Portuguese and customized it to the district needs. The first version, with hard-coded language translation, was prototyped in northern Mozambique in 2000 and has been operational since. Due to the flood in 2000, the southern provinces were not really involved before 2002, when the multi-language version of DHIS was released, making versioning much easier. The uneven distribution of technical infrastructure has made it problematic to scale up district-based HISs since most districts do not have electricity. To overcome this problem, the strategy is to make computers available in the province headquarters so that staff from the districts without computers could come there and enter data. The recent decision to start implementing DHIS nationally from 2004 has led to new requirements for the software: improved user interface, output reports, and the integration with other software applications and reporting systems. The 14 master's students currently at UEM are engaged in carrying out these changes and testing them in two southern provinces in collaboration with MISAU.

The Process of Training and Education

Given the poor human resource base as illustrated by the extremely small numbers of doctors in the country (see Table 3), the development of educational capacity has been a key focus of HISP. An integrated master's program in health informatics has been established (in 2001) through collaboration between the medical and informatics faculties of the UEM, the UWC, and the UiO to

support the development of course material, staff exchange, and sharing of experiences. HISP has conducted a number of training workshops and on-site sessions in the three provinces and students in the master's program are taking part in the action research. The strategy is to develop the UEM master's into an institutional base for a continuous education and training scheme in support of the national HIS development.

India: The Asian Partner in the HISP Network (2000–Ongoing)

The Process of Garnering Political and Financial Support

One of the UiO faculty members is Indian, and his earlier work and contacts in India provided the impetus to initiate HISP processes in Andhra Pradesh in southern India. This state, which is extremely progressive with respect to e-governance based reforms, decided to implement HISP because of their conscious strategy to incorporate global best practices into their local processes. Building upon a contact with a senior government official in the office of the chief minister, HISP received permission to conduct a pilot study in the political constituency of the chief minister in Chittoor district. This official is the information technology advisor to the chief minister of the state and has the political and administrative power to ensure that HISP continues. However, such a strategy has its own risks. In the event of his departure, which is always possible, HISP could be immediately left in a vulnerable situation, requiring the development of new strategies based on the revised situation.¹⁴ In addition, the HISP entry through the political door subsequently became problematic as the health bureaucracy was not

totally enrolled with the interests of HISP, and were themselves more interested in implementing an alternative electronic patient record HIS supported by the World Bank (called FHMIS). This lack of fuller bureaucratic support continues to be a problem to this day, and HISP is continually forced to resort to political intervention to ensure continuance. Late in 2003, however, HISP was commissioned to develop and implement a district database in all districts in Andhra Pradesh. This full scale implementation may be crucial in institutionalizing HISP as a partner at the state level.

The Process of HIS Development

HISP started the project in December 2000 in the Chittoor health district office, attempting a participatory process under circumstances where such an approach is largely foreign. Contributing to this are a number of factors including the physical size and diversity of the health sector (84 primary health care clinics in Chittoor serving nearly 3 million people), various administrative divisions, an extremely hierarchical and centralized structure of working, and many different staff functions each dealing with different kinds of data (involving multiple forms and registers) for various health programs.

The participatory prototyping for the EDS was carried out for over a year, and involved multiple discussions on data elements and forms used with the various staff. The starting point was to identify all of the data items being used from the different reports, put them in one place, discuss their use and how an EDS would reduce efforts of collecting irrelevant data. An initial EDS with about 800 data items was developed and distributed to health workers and managers for discussion and feedback. Through a participatory process including workshops, trials, and wider consultation, the EDS was further reduced to the current one with about 400 elements. The process of implementing the datasets using the DHIS started in nine PHC clinics, representing the chief minister's constituency, in January 2001. After about 6 months of developing the various reports required, a presentation was made to the state health

¹⁴In fact, as we were doing the final revisions of this paper, the election results in Andhra Pradesh had just been announced. The ruling party had been comprehensively voted out, and this is expected to have a significant trickle-down effect on the bureaucracy. The person whom we have described as the supporter of HISP is expected to now leave his post. This will require the HISP team to renegotiate its networks of support in the state.

department, which saw the value of what was done and signed a formal agreement to extend the project to 46 PHC clinics. This support, however, was lukewarm (and on political insistence) because of their preference to FHMIS. Currently efforts are being made to integrate FHMIS and DHIS, the idea being that FHMIS will be used to register the data (patient records), which will then be imported into DHIS to conduct and present the facility-based analysis. If this works, it would be a strategy to address both the scaling and sustaining problems. Since FHMIS is being rolled out to the whole state, HISP can "ride on their back" for state-wide use.

The Process of Training and Education

Unlike the case in Mozambique where the training has been centered largely on province level workshops, in India the training has been focused on individual trainers on-site within particular facilities. While this strategy (when limited to nine PHC clinics) is effective to stimulate individual users, and gradually develop some super-users, it is problematic when needed to be scaled to 84 district PHC clinics and 1300 in the state. Different strategies will need to be adopted, using a mix of the Mozambique and India approaches, using the trained health staff as resources, creating clusters of seven or eight PHC clinics that could be managed by one trainer, or entering into agreements with professional agencies. Cross-country movement of trainers in order to enhance cross-country learning is another approach that has been tried and two experienced trainers from South Africa have visited India (in 2002 and 2004) and conducted courses on the use of health information.

Other Nodes in the HISP Network

A number of countries, particularly in Africa, are attempting to adapt HISP processes including software and training material. There are two major entry points to the network. One is through university collaboration, Ph.D. and master's students, and attempting to build alliances with the

health authorities. This is a relatively time consuming and incremental process as seen in Mozambique and being repeated in Tanzania and Ethiopia. The second entry is through the departments of health, typically supported by some outside actors, often promoted by agencies and various HISP-related and South African actors. An example of this comes from Malawi, a self-initiated node, which has managed, with support from South Africa and supported by first Dutch and then USAID funding, to develop and implement the DHIS nationally. The system was first tested in two pilot districts in 2001 and implemented nationally from January 2002. The Malawian reporting strategy, based on quarterly reporting of monthly data from the facilities to the district where the data is captured in the database, gave ample time (in contrast to a monthly schedule) to fine-tune the system while running it.

The successful development is remarkable given that Malawi is one of the poorest countries in the world, lacking educational and human capacity infrastructure in addition to having weak health institutions. To compensate for some of these asymmetries, collaboration with the Medical College in Malawi was initiated and a 2-week course in HIS from the Mozambique master's was conducted for all district and hospital information officers in 2002 and 2003, which is to be repeated for at least three more years. Furthermore, HISP in South Africa received donor funding¹⁵ from 2003 to support the HIS development in Malawi for a three year period. This strengthens the South African capacity, but also provides a mechanism for rapid transfer of learning and experience.

Initially, Tanzania followed the same approach as Malawi and participated at the UWC summer school (January 2001) together with Malawi representatives, and similar support on the database was provided to them. However, the weak local technical capacity and the fact that there was no external technical or financial support similar to what was provided in Malawi caused this work to

¹⁵Funding from USAID is through the Management Sciences for Health, the same implementing agency as in EQUITY, South Africa.

halt. University collaboration including an agreement with the Ministry of Health was established in 2002 where one Ph.D. student joined the two Tanzanian students enrolled in the master's program in Mozambique. The agreement was to develop a new HIS starting with two districts in one health region and later extending to include full-scale implementation in Dar es Salaam city. Two representatives from the University and the Ministry of Health participated in the HIS course in Malawi in 2002, and a plan to extend the course to Tanzania was made.

Except for Malawi, the remaining three nodes are all in early stages of implementation. We outline these only very briefly to indicate the challenges and problems related to the two modes of entering the HISP network. In Ethiopia, the entry was initiated through a university collaboration enrolling three Ph.D. students and five master's students. An agreement was reached with the health authorities to carry out HIS development in four (federal) health regions and full-scale prototyping of a new HIS in all sub-cities in Addis Ababa has already started (2004). These initiatives coincide with a strong official commitment to develop a new HIS in Ethiopia which, similar to the case in South Africa, is supported by a large USAID funded project,¹⁶ representing a potential HISP partner. Mongolia was initiated through a personal, long-term research-based interaction with one of the authors. This contact went through the Ministry of Health and had political support, but lacks links with universities or development agencies. An insufficient supply of technically competent people, in addition to reshuffling of staff at the Ministry of health that cut HISP off, made it difficult to sustain the project. Initially, the political support in Cuba was strong via the statistical office of the Ministry. Due to a change of political climate in mid-2002, including a change of the minister of health, the political support has evaporated and action halted.

¹⁶John Snow Incorporated is the implementing agency for the United States.

Analysis and Discussion

We turn to a discussion of our network of action perspective structured along three threads. First, we address the issue of sustainability of interventions through vertical (in a district, province, and country) processes of appropriation linked with horizontal (across districts, provinces, and countries) processes of replication and spread. Second, we analyze how HISP, as an extensive network, has to compete with, oppose, or fight alternative initiatives (with associated, alternative networks). To tip a political controversy in your favor, it is necessary to mobilize your network to gain sufficient support. Third, we compare and contrast networks of action with more traditional approaches to action research and underscore differences in criteria, contents, and process.

Building Sustainable Networks

A fundamental point is that sustainable networks are built through ongoing and continuous *translations*, around both the vertical (local appropriation) and horizontal (diffusion) axes. This perspective helps to go beyond merely *recording* the movements of technology, as is the case of the diffusion model, to trying to make these changes happen, which requires understanding, *explaining*, and engaging with the specific dynamics around the uptake, spreading, and sense making involved (Latour 1986).

This translation perspective is well illustrated through the standardization process in South Africa. Standardization of datasets is complex because of the interconnected levels and structures of the health sector, each with their own particular data needs, and the federal structure of the provinces, each with their particular institutional and political set-up. The principle of hierarchy of standards was used to forge compromises between variations in local requirements. More specifically, every local unit was allowed to make local translations, but only in the form of proper extensions of the data set. In other words, the elements of the data set from the level above were inherited. This freedom eased the disagree-

ments within and between the various levels, and enabled the development of national standard data sets to be used across all provinces, as each province in a similar way was allowed to extend its set of data elements.

The HISP team, with the gradual support of the health authorities, advocated this vertical diffusion (across levels) of data standards and associated processes (including the use of indicators) with the horizontal spread within South Africa, from district to district and from province to province. Later, a similar strategy was employed at the international level as the focus on indicators and hierarchy of standards principle became a starting point to the dataset definition effort in other countries. The vertical appropriations in the different countries will no doubt vary. For example, Cuba requires a stronger top-down and politically mandated effort. India, with its starting point of a huge, 800-item primary health care dataset with minimal use of indicators, requires a radical change of information culture but with significant common ground arising from universal health activities related to mother and child health, vaccination, and similarities of the health structure.

Another example of building sustainable networks comes from education and training. A key principle followed was the building of "South-South" horizontal translations (UWC-UEM) together with multi-faculty (medical and informatics at UEM) vertical translations reflected in the Mozambique integrated master's program. This structure, first, allows a weakly resourced UEM to draw upon external resources and set up a much required master's program and, second, allows for the transfer of a wealth of learning and experience on public health from South Africa. The horizontal linkages, across faculties and with the ministry, are an effective way to encourage MISAU to utilize the master's program as a base for an educational scheme to support the national HIS development.

Another important vertical translation concerns the integration of education, research, and action in the health department. Both the doctoral and master's students write their thesis on problems with practical relevance to the health department.

This structure contributes to sustainability as the doctoral students teach and supervise the master's students and, on finishing their Ph.D. thesis, can take overall responsibility for the degree, which can then be transferred from Oslo to Maputo. These vertical translations are further strengthened as the course becomes more international, and this year 14 students¹⁷ from various southern countries, including Mozambique, Tanzania, India, and Ethiopia, are joining, leading to greater sharing of cross-country experiences. A theoretical implication is that institutions should not be viewed in terms of their capacities to constrain, but as an arena for ongoing attempts to develop local routines and hook them up with broader systems. This perspective is in line with the call that researchers must develop dynamic models of institutions (Orlikowski and Barley 2001). This creates horizontal and vertical action research translations (rather than duplications), which facilitates replicable (similar) processes horizontally in a network and cultivates them in each unit of focus vertically. Vertical translations illustrate the fact that as the action research grows deeper, more levels, people, and local networks become involved, and the system is increasingly institutionalized in the local context. Richer experiences lead to the development of more knowledge and research outputs.

A third example around the DHIS software development emphasizes the horizontal translations, based on a strong vertical structure. The DHIS development involves a core software team in South Africa, and different software teams in the respective countries involved in the customization and adaptation of the new versions being continuously developed in South Africa. The multi-lingual functionality of the software, now available in English, Portuguese, Spanish, Mongolian, Norwegian, and Telugu (a regional Indian language) has contributed to its rapid uptake in different countries. At the vertical level, an important challenge is to strengthen and provide more funds to the South African team. A Norwegian

¹⁷The first group in the master's program had two students each from Mozambique and Tanzania. After graduation, all four are planning to enroll in the doctoral program in Oslo in 2004.

researcher, in South Africa for the past 6 years, has spearheaded the development efforts, serving as the point of interface between HISP and the health authorities in relation to software development. This local network is attempting to become sustainable by bidding for national and international level development and implementation contracts, as in Malawi and Nigeria.

The Politics of Networks

The health care sector in developing countries is intrinsically political. It circles around the inherent scarcity of resources and involves a number of actors with different agendas such as donor agencies, health activists, non-governmental organizations, vendors, consultants, and politicians (Bowker and Star 1999; Castells 2000; Timmermanns and Berg 2003). This requires HISP to fully engage in politics if it is ever to acquire sustainability. We analyze the strategies employed by the HISP team members, some planned, others less so, in maneuvering among and against alternative initiatives with accompanying networks. Of decisive importance were the political, institutional, and economic settings of the different countries. The differences in the political economy of the countries gave rise to distinct strategies of meeting opposition.

In South Africa, where the public health sector was to be reconstructed after 1994, HISP had a relatively open space to define dataset standards. In contrast, India, with its strong bureaucracy and British colonial legacy that emphasizes central control and hierarchy, had an extremely limited open space to navigate, with even small changes on the ground requiring state-level approvals. In Cuba, characterized by a strong Soviet-influenced political structure and a health system which prides its self-sufficiency, the space to operate for HISP was opened up through initial strong political support. However, HISP rapidly met with much opposition. In Mozambique, the competition between a number of actors representing different strategies and agendas has made it difficult to align the network and develop a coherent strategy based on relative consensus and to achieve suffi-

cient political support. In particular, the competition with the ambitious, costly HIS initiative driven by a major, international vendor proved problematic. Even without establishing funding for this initiative, the surrounding network of supporters both in political and health administrative circles and also some donor agencies blocked further support for HISP. In this situation, HISP attempted to work around this obstacle by (1) setting up local facilities in a bottom-up fashion and (2) engaging in negotiations at the MISAU level. This strategy seems to have succeeded. In Andhra Pradesh in India, the competing HIS (called FHMIS) is at the moment attempting integration with DHIS, thus forging a political compromise and alliance between potential competitors.

The politics of health information (Timmermanns and Berg 2003) is another key consideration in network building. The underlying philosophy of HISP efforts to make health information more visible and accessible is often in conflict with the agendas of vested interests that prefer to keep the problem invisible. This turns HISP into a kind of counter-network (Castells 2000). In South Africa, the local calculation of indicators about resources (including budgets, and number of health staff) has on several occasions made visible huge asymmetries of resource distribution. The local use of HISP feeds into and interacts with the ongoing political controversies of health priorities as played out by local health workers.

Being part of the formal health structure, and yet at the same time out of it, as HISP needs to do at times, requires varying approaches in different settings. In India, we have a champion who, while agreeing with the HISP philosophy, also has the power to see we are not thrown out. In other places there is the strategy of gradually institutionalizing it locally, and slowly demonstrating benefits, while waiting for competing systems to fall through. Dealing with the politics of health networks requires strategies that are reasonably open-ended, which encourage improvised action (Orlikowski 1996). In essence, HISP has to be constantly aligned with the changing institutional, political, and cultural configuration at the various sites.

Models of Action Research, Revisited

In this section, we compare and contrast our network of action perspective with more traditional accounts of action research. We choose to emphasize the differences here in an attempt to make explicit where and how we see our perspective as a contribution to the discourse on action research. We discuss three aspects of our networks of action perspective: how relevance is an important criteria when understood as political relevance; how the action research processes must be flexible; how action research interventions need to be sustainable.

Relevance

A key, ongoing debate in action research concerns the question of *rigor*, often at the expense of *relevance* (Avison et al. 2001). This problem of “serving two masters” (the academic discipline on the one hand, and the practical domain—health in this case—on the other) (Kock and Lau 2001), relates to broader debates in IS on the need to establish practices, models and criteria for high-quality research (Avison et al. 2001; Klein and Myers 1999; Lee 1999).

HISP seeks to address the important and significant problem of health care delivery in poor countries by strengthening the capacity of health staff to effectively deal with HIS, and use it to support action aimed at improving the health status of marginalized groups. The HISP approach thus is based on the additional criteria for action, namely of political relevance. This gives rise to a criterion for action research to help the participants “to control their own destinies more effectively and to keep improving their capacity to do so” (Greenwood and Levin 2000, p. 6). This illustrates that the action research approach adopted in HISP is in opposition to the claims that “action research is a research approach [only], like experimental research, not an epistemology” (Kock and Lau 2001, p. 6). HISP feeds concretely into the social

construction of facts through its focus on essential datasets and indicators, underscoring that action research is basically an epistemological argument about how truth claims are underpinned (Greenwood and Levin 2000). To illustrate, by inscribing the use of indicators in the DHIS, HISP seeks to develop a stronger awareness of viewing data not as raw numbers, but in relation to the target population. Time-series graphs showing comparisons across facilities help to introduce new criteria around performance.

Flexibility of the Research Processes

HISP challenges the tendency in descriptions of action research to separate the process into (more or less) well-defined phases. Susman and Evered’s (1978) classic model outlines five phases: diagnosing, action planning, action taking, evaluating, and specifying learning. While these cycles are implicit and ongoing in certain forms of action, they cannot be categorized neatly into different phases with a clear start and end. With its focus on sustainability and scale, HISP is characterized by a significant element of flexibility and improvisation (Orlikowski 1996) and is intrinsically open-ended in its ambition. External, political events, such as a pressure in India to demonstrate results before the next election, often requires the political exigencies to supersede academic needs of following well-defined phases. As a result, HISP comes closer to Gustaven’s (2001, p. 22) description of earlier network-based action research where

a striking aspect [of the network based action research] is that there is no unified, “total” picture to be found, be it on the side of the “diagnosis” or of the “remedies.”

Another important question concerns whether or not there is an end-point to the research. When do the researchers pull out? There are difficult dilemmas here which we merely identify, but note that this is an issue largely not addressed in current action research debates.

Scaling and Making Sustainable the Action Research Process Itself

We suggest that the action research projects must be sustainable. In response to this, a key strategy adopted by HISP is to ensure the heterogeneity within the network of participating actors, and try to align their interests with that of the HISP approach and philosophy. As opposed to the relatively dichotomous separation of the practitioners from the researchers (Avison et al. 2001, p. 27), there is a wide variation in type, level of involvement, and interest in the HISP network: some are committed full-time (like two of the authors), others only part-time (as the third); some are based locally. While some visit for shorter or longer periods; others are established researchers. While some are pursuing a master's or Ph.D. degree, others are strongly committed to the health reform agenda of HISP and still others are attracted as much to the analytical issues involved. These differences in agendas are, as ANT reminds us (Latour 1986), the characteristics of a robust (i.e., aligned) network. Hence, HISP very much reaffirms Gustavsen's (2001, p. 20) point that "pluralism and many sidedness is the order rather than uniformity and single directedness" in network based action research.

Conclusion

The core theme of this paper, how to facilitate politically charged changes and build capacity to sustain them, is definitely a complex problem. Hopefully, we made it sufficiently clear that we do not naively promote simple fixes. However, no progress will be made until the problem is defined and debated. By way of concluding, we formulate our contributions implied in our analysis of HISP. These contributions, we believe, belong to three areas.

First, our analysis contributes to the methodological discourse in IS on action research. We identify a vital, yet underdeveloped, quality criteria for action research in IS, namely the sustainability of interventions. Too often, action research pro-

jects end up with changes that last only as long as the attention of action researchers remains or, similarly, end up with a prototype but never a routinely used, institutionalized information system. Our contribution lies, in part, in reminding the IS action research community that this problem was recognized within the earlier Scandinavian-based (non-IS) action research tradition (Elden and Chisholm 1993; Engelstad and Gustavsen 1993; Gustavsen 2001). More importantly, we contribute constructively to describe an alternative approach to action research that addresses the criteria of sustainability. This approach, called networks of action, is characterized by (1) abandoning singular, one-site (typically one organization) action research projects in favor of a network of sites, (2) generating local, self-sufficient learning processes together with working mechanisms for the distribution of appropriately formatted experiences across sites in the form of vertical and horizontal flows, (3) nurturing a robust, heterogeneous collection of actors likely to pursue distinct, yet sufficiently similar (Callon 1991; Latour 1986), agendas, and (4) aligning interventions with the surrounding configurations of existing institutions, competing projects, and efforts as well as everyday practices. Action research cannot be sustainable when conceived of in a vacuum decoupled from the surrounding social, cultural, and historical context. Action research efforts of the type of HISP provide unique opportunities to explore the meshing of targeted action with emerging, dynamically shifting configurations of institutional arrangements (Orlikowski and Barley 2001).

Second, our analysis of HISP contributes to practical and strategic guidelines for IS in developing countries in general and within health care in particular. As reviewed earlier, the lack of sustainability of working information systems in developing countries is striking. Our network of action perspective underscores at a minimum (1) the importance of establishing networks of sites, rather than singular locations, to facilitate the necessary processes of learning, and (2) suggesting mechanisms for the vertical and horizontal flows of software, training, and sharing of experiences. From the wide variations in success for HISP in the different countries, general lessons about

distributed, sustainable learning processes may be identified. The Malawi case is relevant here. They have managed, on their own initiative, to implement important elements of the HISP approach nationwide. While the direct and ongoing support has been modest, it has nevertheless been significant: Dutch and U.S.-based groups aligned with HISP South Africa. Furthermore, the HISP Mozambique team has been running a course addressing information officers at the district level annually since 2002. The alignment with the larger HISP network is thus robust and there is a national team that is being trained. Countries that have tried to apply the HISP approach without a similar level of alignment with the HISP network, including Mongolia, have performed less well. Similarly the process of standardization of information needs (essential data sets) from HISP represents a general lesson. The evolutionary—start small and grow organically—participatory process of large-scale prototyping is applicable to a wider range of settings.

Third, our analysis has explicitly been around the action research efforts. We believe, however, that the lessons learned have relevance beyond action research efforts. In particular, the problems associated with the development of organizationally distributed, infrastructural IS where resources are limited are very similar to HISP (Hanseth and Aanestad 2003; Lyytinen 2001). Our network of action perspective provides relevant lessons on how to spread and institutionalize this type of IS.

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References

- ANC. *A National Health Plan for South Africa*, African National Congress, Johannesburg, South Africa, 1994a.
- ANC. *The Reconstruction and Development Programme*, African National Congress, Johannesburg, South Africa, 1994b.
- Avgerou, C., and Walsham, G. (Eds.). *Information Technology in Context: Studies from the Perspective of Developing Countries*, Ashgate Publishing, Aldershot, UK, 2000.
- Avison, D., Baskerville, R., and Myers, M. "Controlling Action Research Projects," *Information Technology and People* (14:1), 2001, pp. 28-45.
- Barret, T., and Whiteside, A. *AIDS in the 21st Century: Disease and Globalisation*, Palgrave Macmillian, New York, 2002.
- Baskerville, R., and Wood-Harper, A. T. "Diversity in Action Research Methods," *European Journal of Information Systems* (7:2), 1998, pp. 90-107.
- Bjerknes, G., Ehn, P., and Kyng, M. (Eds.). *Computers and Democracy*, Ashgate Publications, Aldershot, UK, 1987.
- Braa, J., and Hedberg, C. "The Struggle for District-Based Health Information Systems in South Africa," *The Information Society* (18:2), 2002, pp. 113-127.
- Braa, J., Heywood A., and Shung King, M. "District Level Information Systems: Two Cases from South Africa," *Methods of Information in Medicine* (36:2), 1997, pp. 115-121.
- Braa, J., Macome E., Mavimbe, J. C., da Costa J. L., Nhampossa J. L., Bonifacio J., Manave A., and Sitói, A. "A Study of the Actual and Potential Usage of Information and Communication Technology at District and Provincial Levels in Mozambique with a Focus on the Health Sector," *Electronic Journal in Information Systems for Developing Countries* (5:2), 2001, pp. 1-29.

- Bowker, G., and Star, S. L. *Sorting Things Out: Classification and its Consequences*, MIT Press, Cambridge, MA, 1999.
- Callon, M. "Techno-Economic Networks and Irreversibility," in *A Sociology of Monsters: Essays on Power, Technology and Domination*, J. Law (Ed.), Routledge, London, 1991, pp. 132-161.
- Castells, M. "Globalization in the Network Society," *Prometheus Journal* (4), 2000, pp. 109-123.
- Castells, M. *The Rise of the Network Society*, Basil Blackwell, Oxford, 1996.
- Czarniawska, B. *A Tale of Three Cities: Or the Globalization of City Management*, Oxford University Press, Oxford, 2002.
- de Kadt, E. "Making Health Policy Management Intersectorial: Issues of Information Analysis and Use in Less Developed Countries," *Social Science and Medicine* (29:4), 1989, pp. 503-514.
- Elden, M., and Chisholm, R. F. "Emerging Varieties of Action Research: Introduction to the Special Issue," *Human Relations* (45:2), February 1993, pp. 121-142.
- Engelstad, P., and Gustavsen, B. "Swedish Network Development for Implementing National Work Reform Strategy," *Human Relations* (46:2), February 1993, pp. 219-248.
- Greenbaum, J., and Kyng, M. (Eds.). *Design at Work*, Lawrence Erlbaum, Mahwah, NJ, 1991.
- Greenwood, D., and Levin, M. *Introduction to Action Research*, Sage Publications, Thousand Oaks, CA, 2000.
- Gustavsen, B. "Theory and Practice: The Mediating Discourse," in *Handbook of Action Research: Participative Inquiry and Practice*, P. Reason and H. Bradbury (Eds.), Sage Publications, London, 2001, pp. 17-26.
- Hanseth, O., and Aanestad, M. "Bootstrapping Networks, Infrastructures and Communities," *Methods of Information in Medicine* (42:4), 2003, pp. 384-391.
- Hanseth, O., and Monteiro, E. "Inscribing Behaviour in Information Infrastructure," *Accounting, Management and Information Technologies* (7:4), 1997, pp. 183-211.
- Heeks, R., and Baark, E. "Evaluation of Donor Funded Technology Projects in China," Working Paper, Institute for Development Policy and Management (IDPM), University of Manchester, 1999.
- Klein, H. K., and Myers, M. D. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems," *MIS Quarterly* (23:1), 1999, pp. 67-93.
- Krishna, S., and Madon, S. (Eds.). *Proceedings of the IFIP 9.4 Conference on Socio-economic Impact of Computers in Developing Countries*, Bangalore, India, May 2001.
- Kock, N., and Lau, F. "Information Systems Action Research: Serving Two Demanding Masters," *Information Technology and People* 14(1), 2001, pp. 6-11.
- Latour, B. "The Power of Association," in *Power, Action and Belief*, J. Law (Ed.), Routledge and Kegan Paul, London, 1986, pp. 261-277.
- Lee, A. "Rigor and Relevance in MIS Research: Beyond the Approach of Positivism Alone," *MIS Quarterly* (23:1), 1999, pp. 29-34.
- Littlejohns, P., Wyatt, J. C., and Garvican, L. "Evaluating Computerised Health Information Systems: Hard Lessons Still to Be Learnt," *British Medical Journal* (26), April 2003, pp. 860-863.
- Lippeveld, T., Sauerborn, R., and Bodart, T. (Eds.) *Design and Implementation of Health Information Systems*, World Health Organization, Washington, DC, 2000.
- Lyytinen, K. "Achieving High Momentum in the Evolution of Wireless Infrastructures: The Battle Over the 1G Solutions," *Telecommunications Policy* (26:3-4), 2002, pp. 197-217.
- Nygaard, K. "The 'Iron and Metal Project': Trade Union Participation," in *Computers Dividing Man and Work*, Å. Sandberg (Ed.), Swedish Center for Work Life, Demos Project Report No. 13, Utbildningsproduktion, Malmö, Sweden, 1979, pp. 94-107.
- Orlikowski, W. "Improvising Organizational Transformation Over Time: A Situated Change Perspective," *Information Systems Research* (7:1), 1996, pp. 63-92.
- Orlikowski, W., and Barley, S. "Technology and Institutions: What Can Research on Information Technology and Research on Organizations Learn from Each Other?," *MIS Quarterly* (25:2), 2001, pp. 145-165.
- Sahay, S., Miller, J., and Roode, D. (Eds.). *Proceedings of the IFIP 9.4 Conference on Socio-Economic Impact of Computers in Developing Countries: Information Flows, Local*

- Improvisations and Work Practices*, Cape Town, South Africa, 2000.
- Sahay, S., and Walsham, G. *Using GIS in Developing Countries: Social and Management Issues*, UNIDO Publications, Vienna, 1997
- Sandford, P., Annet, H., and Cibulski, R. "What Can Information Systems Do for Primary Health Care? An International Perspective," *Social Science and Medicine* (34:11), 1992, pp. 1077-1087.
- Sandford, P., Kanga, G. J., and Ahmed A. M. "The Management of Health Services in Tanzania a Plea for Health Sector Reform," *The International Journal of Health Planning and Management* (9:4), 1994, pp. 295-308.
- Sen, A. *Development as Freedom*, Oxford University Press, Oxford, 1999.
- Shaw, V. "The Development of an Information System for District Hospitals: A Case Study from the Eastern Cape Province, South Africa," in *Proceedings of the IFIP 9.4 Conference on Socio-Economic Impact of Computers in Developing Countries*, S. Krishna and S. Madon (Eds.), Bangalore, India, May 2001, pp. 612-624.
- Simwanza, A., and Church, M. "Establishment of an Information Culture: Achievements and Challenges in Zambia," in *Proceedings of the RHINO Workshop on Issues and Innovation in Routine Health Information in Developing Countries in Conjunction with Measure Evaluation*, USAID, the World Bank and the World Health Organization, Potomac, MD, March 14-16, 2001, pp. 227-234.
- Susman, G., and Evered, R. "An Assessment of the Scientific Merits of Action Research," *Administrative Science Quarterly* (23:4), 1978, pp. 582-603.
- Timmermanns, S., and Berg, M. *The Gold Standard: The Challenge of Evidence-Based Medicine and Standardization in Health Care*, Temple University Press, Philadelphia, 2003.
- Walsham, G. "Actor-Network Theory and IS Research: Current Status and Future Prospects," in *Information Systems and Qualitative Research*, A. S. Lee, J. Liebenau, and J. I. DeGross (Eds.), Chapman & Hall, London, 1997, pp. 466-480.
- Walsham, G., and Sahay, S. "GIS for District-Level Administration in India: Problems and Opportunities," *MIS Quarterly* (23:1), 1999, pp. 39-66.
- WHO. *Information Support for New Public Health Action at the District Level: Report of a WHO Expert Committee*, World Health Organization. Technical Report Series, No. 845, Geneva, 1994, pp. 1-31.
- Wilson, R., Rohde, J., Puchert, R., and Hedberg, C. "South Africa's District Health Information System: Case Study from Eastern Cape Province," in *Proceedings of the RHINO Workshop on Issues and Innovation in Routine Health Information in Developing Countries in Conjunction with Measure Evaluation*, USAID, the World Bank and the World Health Organization, Potomac, MD, March 14-16, 2001, pp. 81-93.

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