

Research Article

Enacting Openness in ICT4D Research

Melissa Loudon

melissa.loudon@gmail.com
Doctoral Student
University of Southern
California
Annenberg School for
Communication & Journalism
3650 Watt Way
Los Angeles, CA 90089
USA

Ulrike Rivett

ulrike.rivett@uct.ac.za
Associate Professor
University of Cape Town
Department of Civil
Engineering
Private Bag, Rondebosch 7709
South Africa

Abstract

This article explores the role of ICT4D research in producing “actionable knowledge” (Hearn & Foth, 2005) for development. We consider how a frame of openness (Smith & Elder, 2010), interpreted here as an active process of engagement, knowledge sharing, and co-creation, might guide ICT4D research. Our analysis is directed at both the project and institutional levels, focusing particularly on universities in the Global South.

The case of iDART, a pharmacy system for antiretroviral drug dispensing in remote and underresourced public health clinics in South Africa, is interrogated as an example of an open approach. As of early 2010, iDART managed antiretroviral drug dispensing for approximately 150,000 patients in South Africa, and the research group that initially developed it had spun out into a separate nonprofit.

In iDART and related projects, we have tried to enact a shift toward openness in both the technologies we work with and the system development process. We have also engaged with the research process itself, trying to establish a developmental understanding of our work as ICT4D researchers, as well as with the university as an institutional structure. The results demonstrate barriers on both practical and institutional levels, but also encouraging successes. The success of iDART as a model for knowledge production is well framed by an open approach to ICT4D research.

In the 2003 operational plan for HIV/AIDS, the South African government clarified that antiretroviral treatment (ART) increased the life expectancy of people living with AIDS. This statement, which today is uncontested, ended a decade of bruising conflict over the state’s obligation to provide treatment for people living with HIV/AIDS. Thousands had died as politicians dragged their heels, and when the government proved intractable, the battle moved to the courts.

Following a series of successful legal challenges and the development of the operational plan, attention turned to the practical complexity of managing the supply of medication to the most rural areas (Wood et al., 2008). With the full ART rollout, the Department of Health (DOH) set the ambitious target of treating 80% of all people requiring ARVs (antiretroviral drugs) by 2011 (DOH, 2007). Effective and sustainable treatment with ARVs requires an adherence rate of 95% to prevent the development of drug resistance in individual patients, as well as possible mutation of the virus. Additionally, the treatment requires a complex time-and-diet regime, and side effects need to be monitored regularly (Bekker et al., 2003). For under-resourced primary health care centers in disadvantaged areas, HIV/AIDS treatment, and particularly the requirement to monitor patients regularly, seemed a nearly impossible task.

ENACTING OPENNESS IN ICT4D RESEARCH

iDART—intelligent Dispensing of Antiretroviral Treatment—is an electronic pharmacy system designed to increase the capacity of remote and under-resourced clinics providing ART. iDART began in 2003 as part of a research collaboration called Cell-Life. From 2001 to 2006, Cell-Life existed within the University of Cape Town and the Cape Peninsula University of Technology (CPUT). Intentionally diverse, the collaboration included students and faculty from engineering, the health sciences, and computer science. In 2006, Cell-Life became a nonprofit organization and was spun out of the University of Cape Town. This coincided with a shift in focus from primarily being a research organization to including a mix of research and implementation support, prompted partly by the growing number of sites using the software and requiring such support. As of mid 2010, there are over 20 host organizations (NGOs or funders) managing 67 iDART sites, covering all nine provinces of South Africa. Approximately 150,000 patients receive their medication through iDART each month. This represents nearly one-sixth of all patients on state- or donor-sponsored ART.

As a research group, Cell-Life originated as a response to a critical development problem—the HIV pandemic—that was unprecedented in both scale and structure. HIV disproportionately affects the rural areas of South Africa, where services are least developed. The public health system, emerging from decades of Apartheid neglect, was already overburdened. An ART rollout of the scale required had never been tried in a developed country, let alone in the developing world. The novelty of the problem mobilized the research community. There was also a very real sense of urgency—people were dying, and the imperative of “actionable knowledge” was keenly felt.

Seven years later, iDART has made the transition from research project to large-scale implementation, with sustained partnerships with a large number and wide variety of host organizations and funders.

In this article, we reflect on the process of developing and implementing iDART as a model for ICT4D research projects that address a national development imperative. Our analysis is grounded in experience, is reflective, and is part of our ongoing learning. Both authors have been directly involved, in various capacities, in iDART and Cell-Life.

The starting point for the discussion is the con-

cept of Open Development, proposed by Smith and Elder (2010), as a way of organizing social activities for development benefits that favors:

- universal over restricted access to communication tools and information;
- universal over restricted participation in informal and formal groups/institutions;
- collaborative over centralized production of cultural, economic, or other content.

Translated into the landscape of university-based academic research, we understand openness as a way of doing research that actively promotes:

- universal over restricted access to research products;
- universal over restricted participation in the research process;
- collaborative over centralized production of knowledge, and recognition of diversity in knowledge systems.

Many theoretical ingredients for a research concept based on openness are already available. Higher education, development studies, and information systems design have all engaged with the issue of participation, whether from a pragmatic standpoint (arguing that involving more stakeholders achieves better outcomes), or from an ideological one. The open access movement promotes universal access to research products, as do research initiatives with an ideological commitment to open source software. There is also an established critique of the monolithic and exclusionary nature of traditional academic knowledge production, which methodological approaches, such as action research, explicitly confront.

The analytical framework for this article organizes observations on openness, both from the literature and the discussion of the iDART case, into three areas. This framework reflects our roles in the project, as well as the natural disciplinary divisions embodied in the literature. It also embodies a sense of combined (sometimes conflicting) roles common among both researchers and practitioners of ICT4D:

- openness in system design and implementation;
- openness in ICT4D research;
- openness and the developmental role of universities in the Global South.

The following section uses this framework to present the theory that informs our understanding of openness in ICT4D research. Table 1, placed at the end of the theory section, maps out theoretical concepts, both in relation to our analytical framework, and to Smith and Elder's three dimensions of openness.

Theoretical Ingredients for an Open Approach to ICT4D Research

Openness in System Design and Implementation

Research in ICT4D has a normative orientation, seeking to influence policy or practice in the ultimate service of development goals. iDART, implemented in the public health sector at the local (primary care) level, arose amidst an academic discourse of overwhelming optimism about the potential of e-government for development (Heeks & Bailur, 2007). The problematic nature of this soon became clear, and by 2003, it was reported that most government information systems projects in the developing world had ended in either partial or total failure (Heeks, 2003).

There is a vast body of work in information systems (IS) dealing with IS project failure, including many examples from the developing world. For reviews of this literature, see Dada (2006), Pardo and Scholl (2002), and Heeks (2002). We know that systems have failed because their implementers have tried to force an unwanted or contentious change in organizational processes. Another reported reason has been that the required technology, such as hardware and connectivity, did not exist or was not maintainable due to limited human, technical, and financial resources. In general, the literature on information systems failure suggests that failure occurs because some aspect of the system context—social, technical, or political—is inadequately understood. In developing countries, the potential for “design-reality gaps” (Heeks, 2002) is particularly acute.

In addition to factors operating at project level, the stubborn persistence of information systems failure suggests a broader systemic problem. The structure and realization of the ICT “ecosystem”—from technologies, implementation, and development processes to ICT research and teaching—do not appear to promote success in ICT4D projects. Crucial

gaps exist between technology and context, design and reality, and project planning and development (expensive, high-intensity, single-location work amenable to project-based funding approaches), and ongoing support and implementation (low-budget, dispersed, and far harder to control and fund).

If technology is understood broadly, the problem described is a familiar one in studies of failed development projects. Pragmatic prescriptions emphasize tools for project planning, often as a way to highlight potential problem areas. Other tools and methods provide a simplified way to communicate technical and project management concepts to a mixed audience. From the perspective of openness, this last point is crucial. System design methodologies premised on improving communication between technical and nontechnical stakeholder groups, such as ETHICS (Mumford & Weir, 1976) and Soft Systems (Checkland & Scholes, 1989), as well as Blake and Tucker's Socially Aware Software Engineering (2006), are potential ingredients for an openness-based approach to system design and development in ICT4D projects. Most mainstream work has emphasized the technical utility of user participation in IS, but there are also authors (including Mumford, as well as Hirschheim & Klein, 1994; Byrne & Sahay, 2007; and Blake & Tucker, 2006) who take the more radical view of participation as a condition of worker ownership of the tools of work.

The issue of participation has also been addressed in development studies, from Chambers (1995), through virtual ubiquity in mainstream development discourse, to a backlash against the “tyranny” of participation (Cooke & Kothari, 2001). In information systems projects, Heeks' (1999) cautionary article is emphatic about the difficulties of achieving equitable and effective participation. The important point here is that, despite differing views on its purpose, and acknowledging the practical challenges it poses, the idea of participation enjoys broad support in both IS and development studies. Like broad-based communication, participation seems a natural goal for an approach to system design based on openness.

Openness in ICT4D Research

Research approaches privileging participation have also emerged, particularly those connected to the ideas of socially responsive research and “democratizing knowledge” (Vaillancourt, 2005). Action

ENACTING OPENNESS IN ICT4D RESEARCH

research, which is carried out through continuous engagement with the study community and encourages redefining research objectives based on their self-definition of needs (Rabinovitch, 2004), is clearly aligned with participation. Here, too, there are both pragmatic and ideological justifications for increasing participation. Crewe and Young (2002) take a pragmatic stance, arguing that wider participation may increase the relevance of research to policy by helping to build “legitimacy chains” to informants. For Reason and Bradbury (2007), on the other hand, action research is:

a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment . . . in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities.

This definition recognizes action research as an expression of a specific worldview. It also makes explicit the normative orientation of action research work, where the primary goal of the research is to effect goal-oriented change. Against positivist claims of an objective reality that exists apart from the research process, action research aims to influence the shifting, subjective “reality” that is uncovered. Participation is a driver of change, but it is also a democratic means of allowing the frame of the people who will be directly affected to determine the kind of change that is desirable. This observation links to openness as favoring universal over restricted participation in the research process—including defining research priorities.

This shift away from the positivist paradigm of traditional scientific knowledge production is inherently political. Action research, in its rejection of monolithic knowledge claims, also rejects the objectivity claim of technical expertise. The “legitimizing discourse” (Rojo van Dijk, in Thompson, 2004) of interventions based on a supposedly neutral technical goal (Wilson, 1997) is similarly denied. In its place, Wilson (2007) imagines a continuous striving toward Habermas’ “ideal speech situation,” with “genuine dialogue between actors, where different knowledges are valued as a source of creative learning and hence new knowledge.” The primary goal

of the researcher becomes progressive attainment of the ideal speech situation, which, in itself, is already the ideal of collaborative production of knowledge.

Despite arising from a very different literature, the concept of communities of practice (Soeftestad, 2001) provides a lever to understand collaborative production of knowledge in practical terms. In both production and dissemination, the researcher is understood as embedded within a wide community of information systems stakeholders (Blake & Tucker, 2006; Byrne & Sahay, 2007), with the ultimate aim of the research process being to develop “actionable knowledge” (Hearn & Foth, 2005) for a diverse group. Communities of practice, which develop over time based on shared experience and aligned goals, may describe a mechanism for producing “actionable knowledge” outside of any formal research agenda, and beyond the timeline of single research projects.

Openness and the Development of Universities in the Global South

For Brett (2009), development is best analyzed—and interventions best operationalized—at the institutional, rather than the individual, level. For ICT4D research, this means interrogating the research process not just in individual projects, but also in terms of the role of the university in national development. Brett’s “liberal institutional pluralism” holds the following: [O]pen, pluralistic and science-based institutions are difficult to create . . . [L]iberal models are crucial to all attempts at social and political emancipation, but institutionalizing them is not just a technical problem but generates practical challenges that demand a credible theory of political agency and practice that has to operate at both macro- and micro-levels. (ibid., p. 306). An open approach to ICT4D research, backed by the theoretical ingredients cited in this paper, represents one imagining of a liberal model.

Speaking to knowledge production, Brett acknowledges the research-policy-practice gap among development theorists, who “fail to ask who might be willing to implement their recommendations” in a nebulous and ill-defined community of “practitioners” (ibid., p. 21). An open system of knowledge should be structured such that theorists are encouraged to confront issues of agency and power in the implementer community. Pluralism works only when it is engaged with local knowledge

Table 1. Theoretical Concepts Summary.

	System design and implementation	ICT4D research	Openness and development in Global South universities
Universal over restricted access to research products	Open source software development	Research-policy-practice links, communities of practice, "actionable knowledge"	"Mode 2" knowledge production, alternatives to traditional publication models
Universal over restricted participation in the research process	Sociotechnical systems design methodologies	Action research, stakeholder engagement, researcher as facilitator	Recognition of Gramscian "organic intellectuals" in knowledge production and dissemination
Collaborative over centralized production of knowledge, and recognition of diversity in knowledge systems	Emancipatory and neo-humanist approaches—ETHICS, soft systems, social shaping	Ideal of knowledge production as a Habermasian "ideal speech situation"	Institutions and development in late-developing countries

systems, and with the crucial knowledge networks of "organic intellectuals"—a Gramscian concept understood by Brett as "teachers, priests, traditional leaders and local activists" (*ibid.*, p. 306).

The starting point of a liberal and pluralistic understanding of the institutional nature of universities in the Global South has to be that knowledge is developed and used—and should be understood—within a particular context. Speaking to applied fields generally, Gibbons et al. (1994) acknowledge context in their concept of "Mode 2" knowledge production—"socially distributed, application-oriented, trans-disciplinary, and subject to multiple accountabilities." Unlike in information systems design or the planning of development interventions, the assumption here is not simply that context should be taken into account as part of the design process. The context of knowledge production, embodied in the structure of institutions and the groups that participate, shapes the knowledge that is produced.

Incentive structures and exclusion are as important as the way knowledge is communicated and disseminated. As Nowotny et al. (2003) recognize in a follow-up article on the "Mode 2" thesis, the reciprocity of "science speaking to society" and "society speaking back to science" is irrevocably marked by exclusion. In familiar dependency terms, Chambers (1999) laments the existence of "cores and peripheries of knowledge," with devastating "centripetal force[s]" that shape knowledge production according to the priorities of the core. Diversity in

knowledge production cannot be achieved without confronting the embeddedness of universities in the Global South within global networks of wealth and power.

A parallel body of work in science and technology studies is concerned with the social shaping of technology artifacts. The social shaping movement is concerned with the context and process of technology development, and with exposing the power structures it reflects and reinforces. Williams and Edge describe social shaping in terms of "choices":

Central to SST is the concept that there are "choices" (though not necessarily conscious choices) inherent in both the design of individual artefacts and systems, and in the direction or *trajectory* of innovation programmes. If technology does not emerge from the unfolding of a predetermined logic or a single determinant, then innovation is a "garden of forking paths". Different routes are available, potentially leading to different technological outcomes. Significantly, these choices could have differing implications for society and for particular social groups. (1996, p. 866)

According to social shaping theory, an open system of innovation that enables effective primary control of technology by marginalized groups would result in better outcomes for these groups. This is likely unattainable, however, and even if it were, technology development never takes place in isolation. Kallinikos (2004) observes that human inventions "solidify over time" as they become socially embedded, and remain malleable along fewer and

ENACTING OPENNESS IN ICT4D RESEARCH

fewer dimensions as they increasingly impose their own logic. The choices we have now are determined by those who walked the path before us, and by the long history of technology as a tool in the exercise of political and economic power. A pragmatic response, particularly in the context of widespread information systems failure, is to understand the extent to which openness as a liberal model for research and teaching can be realized in universities in the Global South.

Case Study: iDART, A Pharmacy System for Antiretroviral Dispensing

Cell-Life, a group comprising researchers, students, and medical personnel from the University of Cape Town and the Cape Peninsula University of Technology (CPUT), was created in 2001 to investigate IT systems for HIV management in the public health sector. Together with one of the first groups providing ART to people in the townships of Cape Town, the Desmond Tutu HIV Centre (DTHC), a number of tools were developed to support treatment. Once a large-scale ART rollout began to look likely, DTHC increasingly focused on providing treatment at clinical research sites. This necessitated the development of a basic infrastructure for tracking drug packages through the supply chain, from initial stock arrival to the creation of monthly supply packets, and on through patient collection at remote clinics.

System Description

Together with the DTHC, Cell-Life conceptualized the details of a basic dispensing system for antiretroviral drugs in public primary care centers. The system's core focus was to support pharmacists in dispensing drugs accurately to large numbers of patients by allowing printing of labels and a simple stock control. Barcode scanning was used to reduce dispensing time. The system was written in Java, using open source components to keep it both free of licensing costs and portable across the different operating systems used at primary health facilities.

iDART was designed with the following constraints in mind (after Rivett & Tapson, 2009):

1. The software had to support the core functions of dispensing to HIV-positive patients, but was not initially a full-fledged stock management system.
2. The on-site software setup needed to be implemented within one day, and the available

time for staff training was no more than seven hours. Training was nearly always conducted "on the job" while dispensing to patients.

3. The software needed to be self-explanatory to the extent that new staff could be trained by the existing staff using the software. This was a particularly important point due to the high staff turnover in rural centers. A manual of over 100 pages was produced but never read; two-page "quick guides" were routinely found stuck to pharmacy computers.
4. The software needed to run without Internet connectivity, but still back up the dispensing database to an external server. This was accomplished with a GSM modem that connected directly to the cell phone network.
5. The software had to be flexible enough to allow for different dispensing models, depending on the setup of each clinic. Models included simple on-site dispensing (one month's supply of drugs), multimonth dispensing for patients with good adherence levels, and down-referral dispensing, in which packages made at a central pharmacy would be collected by patients later, from a nurse at a local clinic.

Since pharmacy management and dispensing are fundamentally process-based and numeric, it is relatively easy to transfer these particular aspects into an ICT system. On the other hand, the realities of public health care in resource-constrained settings can make the implementation of systems very difficult (Brown et al., 2006). For this reason, iDART evolved to support a small number of basic tasks, including routine dispensing and capture of basic patient and prescription data. This strong focus on the client and the beneficiary—the public health pharmacist and the HIV-positive person—resulted in a system with functionality that was very different from those of the commercial alternatives.

Implementation Sites

The initial iDART prototype was developed in 2004 for a pilot site of DTHC, the Gugulethu Community Clinic in a township near Cape Town. During 2005, iDART was re-written for use by the DTHC research pharmacy, which was dispensing to small numbers

of patients in the greater Cape Town area. During the period of 2003–2008, research institutions had started to offer support to government clinics at the local level—initially in defiance of the national government, which indicated that a “plan” had to be developed for a national rollout. Capacity was so constrained at the local level that sustainable treatment was not possible without the help, advice, and resources of academics in the health sector. Even so, by 2005, only 14.9% of South Africa’s registered pharmacists were working in the public sector (Health Systems Trust, 2005), and pharmacy services proved to be a major barrier to the rollout.

This atmosphere of social activism, coupled with the notion of having to prove to government that it was possible to provide treatment even in resource-constrained rural areas, was one of the unforeseen enablers of iDART. Since iDART collaborated with DTHC, other research institutions, such as the Medical Research Council of South Africa (MRC), the Reproductive Health Research Unit (RHUR), and the Paediatric Health Research Unit (PHRU) at the University of the Witwatersrand, were aware of the system and its early success. Through this network, contacts were established in rural areas where the various academic institutions offered support, and Cell-Life began to be asked to implement iDART in other university-supported clinics throughout the country.

The first funding for iDART came from the Elton John Foundation and was focused on equipping four sites in rural South Africa with iDART. After that initial funding, iDART was funded indirectly through grants to the various research institutions involved in treatment provision. International AIDS funds, such as PEPFAR (the President’s Emergency Plan for AIDS Relief), relied on pharmacy management and reporting capacity to support their treatment plans. Another key enabler of the rollout of iDART was the strong focus on rural clinics. While there was occasionally a sense of “competition” with other software products in the more urban and peri-urban (“township”) environments, there was no commercial organization that intended to support rural environments. Highly specialized ARV dispensing functionality meant that Cell-Life and iDART were not generally experienced as competition by stock control and pharmacy software suppliers.

When the commitment from government toward a national rollout grew, it became clear that such a

rollout had to include research organizations, many of which had existing treatment programs, as key stakeholders. iDART became part of the rollout as a consequence of early involvement with research sites. This shift brought with it increased complexity at some sites, as the government began to require formal tender and procurement processes. Meanwhile, sites funded by PEPFAR were required to provide specific motivation for using software not developed in the United States.

At the same time, sources of funding diversified. The early model of implementation, in which new sites were assessed individually, and then managed and supported by Cell-Life, was also changing. Broadreach Healthcare, a private company with responsibility for IT systems at several clinics in KwaZulu-Natal, downloaded iDART from Cell-Life’s website and proceeded to implement it themselves (Cell-Life was still involved, but mostly in technical training). This model has since been repeated at several other sites. A front office module for general patient data capture was developed by PHRU, which was using iDART at several sites. The open source license made it possible for Cell-Life to integrate the new module into iDART and make it available to other sites.

Analysis

Openness in System Design and Implementation

In the vast majority of projects undertaken in the South African IT sector, whether in business or government, IT systems are acquired by management, developed by technologists, and provided to passive “users” of systems and services. Whether in a Johannesburg corporation or a rural hospital with intermittent water supply, both systems design methodologies and the products and business models of commercial vendors emulate business-oriented models. Progress is explicitly equated with the acquisition of “modern” technology and expertise (Moodley, 2005).

In Cell-Life projects, we have tried to enact a shift toward openness, both in the technologies we work with—preferring open source and open standards—and in the system development process, through the use of iterative and incremental methods, evolutionary prototyping, and participatory design. This has required a shift in attitude from

ENACTING OPENNESS IN ICT4D RESEARCH

both the developers of the system and the various user groups. Developers, “specialized [into] academic or professional identities” (Ensor, 2003, p. 342) as technical experts, had to learn to be guided by people whose experiences and modes of expression were often profoundly different from their own. Users, for whom previous engagement with software systems was almost always as passive recipients, needed to work with concepts that were often poorly defined or explained. For most pharmacy users, their involvement was severely time-constrained, balanced with existing work responsibilities that were, themselves, often overwhelming. The complex setting of post-Apartheid South Africa added particular tension to this relationship, as the developer/user divide often also represented a racial, cultural, or language divide.

The urgency of the problem and the highly limited time availability of pharmacists were key to our decision to use working prototypes, which allow users to form opinions based on actual experience of the system. In turn, their responses and suggestions feed into iteratively revised design and new features. This process became a particular strength of iDART, particularly in the early days. Where software users experienced the system as malleable, they were more likely to provide constructive feedback on changes to the initial design. Similarly, designers and developers who spent time with system users, soliciting feedback with a mandate to respond to and explore their needs, became an important proxy for users in prioritizing problem areas.

This was, of course, a balancing act. Constantly responding to user requests for changes to iDART became particularly difficult once the exploratory orientation of the initial research project became secondary to considerations of scale. In the transition phase, when iDART was maturing as a research project and growing in its implementation, pressure to make small, individually requested changes to the system to protect personal relationships needed to be balanced against the need to maintain the technical integrity of the code base, and to align software development priorities with funding. This placed significant strain on the development and implementation teams, and it required constant negotiation. Despite this, relationships had immense value in building and maintaining iDART sites as

communities of practice, sustaining knowledge sharing beyond the software itself.

Openness in ICT4D Research

Academic knowledge production is plagued by information silos, both in the way research is produced, and in the dissemination process. Action research, in rejecting positivist claims of independence and emphasizing consensus-building and co-ownership of the research process, aims to address the former. Communities of practice provide a lever with which to understand the latter. Taken together with observations on participation and the role of the researcher, these form the basis for our understanding of openness in the research process.

The collaborative development of software artifacts—as in Blake and Tucker’s Socially Aware software engineering—has been a key factor in developing long-term relationships among developers, implementers, researchers, and stakeholder at project sites in all of Cell-Life’s work. In the case of iDART, Rivett and Tapson (2009) describe multi-stakeholder collaboration in the implementation community:

One of the key partners of the iDART development was the Reproductive Health Research Unit (RHRU) of the University of Witwatersrand. RHRU, being at the forefront of the newest developments in side effects, drug dispensing and other related matters, requested changes to iDART on a regular basis. The changes to the system would subsequently result in Cell-Life offering the updates to all other clinics, which benefited in return from the knowledge of RHRU. A pharmacy assistant in a rural clinic in the North West province described iDART as “a knowledge transfer system between universities and community clinics.”

Technical knowledge production, too, can happen beyond isolated innovators at universities. In the case of iDART, open source software components were used throughout, and the software itself was released under an open source license. The motivation for this diverged somewhat from other projects, in that attracting contributions from other developers to iDART was not a primary goal. An open source release of the software reflected a philosophical orientation on the part of the developers, and it also provided an induction into a community of open source medical systems developers working on medical records systems (for example, the well-

known OpenMRS system, implemented in several South African sites), mobile data collection systems, and related projects. While collaborative software development is the primary activity of these communities, their existence supports much broader knowledge sharing—both formally, through mailing lists and project meetings, and informally, through relationships between individuals and organizations. The open source model of software development and the community that forms around it are mutually reinforcing. Both the artifact (the software) and the community are also typically in existence for longer than any individual research project, forming a latent network of connections beyond discrete project timelines.

Both situations fit well with the concept of communities of practice, but also they highlight the communities' heterogeneous nature. That which constitutes "actionable knowledge" is likely quite different for a health sciences research group, a small IT-sector NGO, and a pharmacy assistant at the frontlines of the HIV/AIDS epidemic. The success of iDART lies in the way the process (the implementation of a software system for ARV dispensing) and the artifact (the software itself) have been able to serve and engage diverse stakeholders. Being able to engage over an extended period, one long enough for trust to be built and relationships to develop, has been a key factor in allowing this to happen. The same applies to the open source medical systems communities, which, while more technical, are nevertheless heterogeneous in both application area and the kinds of organizations that contribute to projects. Over time, the codevelopment of the software system provides a concrete basis and a common point of reference for knowledge sharing.

Cell-Life's ability to catalyze knowledge sharing through communities of practice depended on its position as an enduring organization with multiple sources of funding. Unlike most university-based research groups, where highly structured research projects are undertaken with predetermined activities and goals, Cell-Life was able to undertake the kinds of small pieces of implementation work that bring experience and build the community. Acting as custodians of the iDART system gave the organization a formal intermediary role, facilitating knowledge sharing among heterogeneous groups. Several core groups in similar open source health systems

projects are in a similar position, with the added advantage of wider geographical reach.

In terms of methods, iDART offers a promising model to address the common criticism that development research is undesirably disconnected from policy and practice. Traditional academic work, delineated by narrow specializations, offers no incentive to consider the complex political and structural/institutional limits under which policymakers work (Crewe & Young, 2002). Academic work on failed ICT4D projects is often highly critical, particularly where questions of government expenditure and returns are concerned. This may be useful in accountability terms (although the persistence of expensive and contentious failures suggests some limitations), but it does little to promote mutually influential relationships between researchers and implementing agencies. Instead, it fosters negative perceptions of the potential contribution of academic research. Action research, in which the researcher has a stake in delivering a solution that "works" for all participants, has provided more useful incentives in this regard. iDART developed as a response to a critical problem. The target user group was pharmacy staff working on the frontlines of the HIV pandemic, and the research was evaluated first by how well it met their needs. At one stage, an integration project was undertaken for the innovation unit of the Western Cape provincial government (PAWC), providing learning on both sides in a clash of institutional cultures that, ultimately, had to be worked through (and was, with iDART successfully implemented in four PAWC sites). Such a complex, risky, and time-consuming piece of work is unlikely to be undertaken in an academic setting without the incentives provided by action research.

At the same time, the combination of an urgent development problem and an action research response gave rise to the challenge of balancing academic rigor with the awkward compromises that result from a process where everything is understood to be less than ideal. To move from a closed system of expertise—with the researcher as the expert and the research participants as subjects—to open collaboration, shared learning, and co-ownership of the research process requires a fundamental shift at both personal and institutional levels.

In traditional academic terms, iDART has produced a tiny fraction of the peer-reviewed academic

ENACTING OPENNESS IN ICT4D RESEARCH

publications (two journal papers, neither in an ICT4D or information systems journal, and four conference papers) that would be expected of any similarly long-running and well-funded project. The nonresearch focus of the various funders involved, and their focus on instrumental evaluations, provides part of the explanation for this. Another reason may be the inadequacy of our research training—in common with many ICT4D researchers—in providing tools for reporting action research. Conversely, the position of Cell-Life as an independent NGO with multiple sources of funding has allowed a much more fluid definition of the goals of the iDART project, one in which the community has some influence, as opposed to just the researchers who write the proposals.

Openness and Development at Universities in the Global South

To reconceptualize the role of ICT4D research in national development, it is important to grapple with what an enabling institutional environment for open models might look like. For the near future, universities are still best positioned to develop such models. However, there remain some important structural barriers that need to be addressed. For example, partnerships across disciplines are key to the success of redefining research—social problems are, by nature, multidisciplinary. Yet discipline-specific journals and conferences are still the dominant means of disseminating academic research. A further barrier is the cost-center approach to research projects, resulting in all projects being hosted within one department or faculty for financial reasons, and thereby tacitly discouraging cross- and multidisciplinary research. Cell-Life, which ran projects between the faculties of health science, engineering, and commerce at various stages, constantly encountered barriers to interfaculty collaboration—and it published far less than similar research projects.

Knowledge sharing through intellectual property is another area that requires re-thinking. IP policies that seem to bedevil the ability to share knowledge require formal mechanisms to exempt certain research and initiatives from their stringent criteria (Rivett & Tapson, 2009). The concept of collaborative open source development, where ownership of software and code is shared among many groups, is often both poorly understood by university IP

departments, and poorly addressed in existing guidelines. In the case of iDART, prior work done by Cell-Life in engaging with university management on IP issues was of clear benefit, as the major concerns of both sides had already been aired and addressed. This experience points to the need to establish a critical mass of initiatives with openness as an organizing principle.

The perspective shift described in the previous sections has also highlighted a need to reconsider the skill set of researchers and practitioners. At the level of universities, this means reviewing what is currently taught across a wide range of disciplines, as well as undertaking critical consideration of areas in which, as with research, disciplinary boundaries to teaching are limited in their ability to promote socially responsive approaches. Unfortunately, curricula reviews of existing programs are often biased toward integrating new developments from industry. Attempts to redefine curricula based on local needs face immense barriers, not least in the attitudes of students themselves. Accreditation processes, which specify fixed requirements for curriculum content, impose additional limitations. This is most obvious for programs seeking international accreditations, as was the case in both the undergraduate computer science and engineering programs at the University of Cape Town during the time that Cell-Life was operating there.

As a result, the area in which Cell-Life has been most successful at influencing teaching and learning is not within the general curriculum, but in the supervision of student research projects. iDART was developed in the initial stages as student research. Students benefited by engaging in research within a diverse community of stakeholders, many of whom have very different experiences from their own. Our experience has also been that students who are exposed to socially responsive research often continue to incorporate a development orientation in future work. If the role of universities is to serve the public good, sensitizing students to the development potential of their field is extremely valuable.

A final point on institutional arrangements for ICT4D research concerns engagement with institutional stakeholders beyond the university. In the case of iDART, engagement with multiple levels of government was essential to ensure not only the fit of the system in its immediate context, but also its position in relation to other systems and policy

Table 2. *iDART Case Analysis Summary.*

	System design and implementation	ICT4D research	Openness and development at universities in the Global South
Universal over restricted access to research products	Developing and participating in communities of practice around open source medical systems in the developing world	Research-policy-practice links; action research in context and with a clear organizational outcome; and acceptance of multiple accountabilities: funders, implementers, patients, academic community	Developing and participating in communities of practice around ARV delivery
Universal over restricted participation in the research process	Design by constraints of remote clinics and the public health sector, evolutionary prototyping, time-sensitive training and design sessions with pharmacy staff	Engagement with multiple stakeholders (government, medical/pharmacy professionals, frontline users), action research approach, long timelines	Retraining researchers and students as facilitators/resources, engaging with practitioners as informants for both content and direction of research
Collaborative over centralized production of knowledge, and recognition of diversity in knowledge systems	Longevity of software artifact beyond individual project timelines, sharing of feature requests and innovation through access by distribution clinics to a common software system, and awareness of alternative IP models	Collaboration (disciplinary, researcher-practitioner) catalyzed by a critical development problem, development and support of enduring communities of practice	Challenges of interdisciplinarity within university structures, interfaculty research teams, teaching outside of internationally recognized syllabi, and nontraditional dissemination channels for research products

directions—all of which evolved rapidly as the government grappled with HIV management. Engagement with the private sector at various points also proved essential in developing a foundation for system support at scale, beyond Cell-Life's own capacity.

In achieving cooperation among institutions, iDART is indebted to the process focus and long timelines of action research. The e-government literature has explored productive engagement with government, but perhaps has failed to emphasize the long timelines necessitated by approval processes, staffing constraints, and budget processes. In relation to the private sector, the advent of iDART as a research collaboration made possible the developments of the system that were risky—new, poorly specified, and serving a notoriously difficult sector. The initial research focused on allowing the functional and operational requirements of the new field of antiretroviral dispensing to emerge (Brown et al., 2006). As the focus shifted to broader implementation, the need for flexibility beyond what was available in a university environment resulted in Cell-Life

being spun off as a separate nonprofit entity. Because of a shared understanding of the project developed during Cell-Life's multi-year engagement with the University IP office, we were able to negotiate IP policies (in Cell-Life's case, an open source model) that were flexible enough to accommodate the shift.

Conclusion

The concept of open development usefully frames reflections on iDART as a research-based response to a critical development problem. Over the past 10 years, the project has proven its ability to scale up alongside the ART rollout, and in the process, it has negotiated a transition in its own identity from a university research group to an implementation-focused nonprofit.

Both the system design and the research methods were chosen with the intention of widening participation. In both cases, participatory methods proved both highly valuable, and severely constrained by the time-limited nature of participants' work.

ENACTING OPENNESS IN ICT4D RESEARCH

- In system design, evolutionary prototyping and the development of working prototypes emerged as a valuable method for enabling user participation in the system design process, while also creating a shared sense of the malleable nature of the systems among users, developers, and researchers.
- Participatory action research and involvement with wider open source developer communities contributed to the development of communities of practice, which added diverse stakeholder involvement and the ability to endure beyond individual implementations and systems.

iDART also established the value of a long-running action research approach, where projects are developed over the course of several years, to build a shared, context-sensitive understanding of the system. Openness and cocreation are impossible without relationships at ground level, built in increments as trust is slowly established, and in turn, fundamental to the process of shared development. This matrix of relationships then supports flexible systems and communities, able to reconfigure themselves over the life cycle of the system.

Action research sees the researcher developing into a resource to the project community, rather than remaining an uninvolved observer of a process. By adhering to this principle, iDART succeeded in promoting wider access to research products—both the software and the distributed knowledge developed and shared in the community. However, this came at the expense of traditional academic publication. Action research is challenging to report out of context. The multi-disciplinary nature of the project further complicated its relationship with academia in the relatively rigid, professionalized disciplines of medicine, engineering, and computer science.

In terms of knowledge production, it is clear that the realization of universities as developmental institutions requires a far wider range of expertise in ICT4D than is usually available in the limited fields of information systems and computer science. On an organizational level, universities often struggle to accommodate projects that span disciplines and feature long timelines, diverse stakeholders, and non-traditional knowledge outcomes. Experience within the university in managing these kinds of projects can lead to productive engagement.

The experience of iDART demonstrates important

benefits of open approaches to research, despite practical and structural challenges. Efforts to increase awareness of open alternatives among researchers and practitioners should be supported, and the results should be evaluated critically by the ICT4D community. ■

References

- Blake, E., & Tucker, W. (2006). Socially aware software engineering for the developing world. In P. Cunningham & M. Cunningham (Eds.), *IST-Africa 2006 conference proceedings*. Dublin: International Information Management Corporation.
- Bekker, L.G., Orrell, C., Reader, L., Matoti, K., Cohen, K., Martell, R., Abdullah, J., & Wood, R. (2003). Anti-retroviral therapy in a community clinic: Early lessons from a pilot project. *South African Medical Journal*, 93(6), 458–462.
- Brett, E. (2009). *Reconstructing development theory: International inequality, institutional reform and social emancipation*. Houndmills, Basingstoke, UK: Palgrave Macmillan.
- Brown, S., de Jager, D., Wood, R., & Rivett, U. (2006). A pharmacy stock control management system to effectively monitor and manage patients on ART. *The 4th institution of engineering and technology seminar on appropriate healthcare technologies for developing countries*, (pp. 27–36).
- Byrne, E., & Sahay, S. (2007). Participatory design for social development: A South African case study on community-based health information systems. *Information Technology for Development*, 13(1), 71–94.
- Chambers, R. (1995). Poverty and livelihoods: Whose reality counts? *Environment and Urbanization*, 7(1), 173.
- Chambers, R. (1999). *Rural development: Putting the last first*. London: Longman. Retrieved October 14, 2009, from <http://www.eou.edu/socwomen/support/articles/chambers.pdf>
- Checkland, P. B., & Scholes, J. (1989). *SSM in action*. Chichester, UK: John Wiley & Sons Ltd.
- Cooke, B., & Kothari, U. (Eds.). (2001). *Participation: The new tyranny?* London: Zed Books.

- Crewe, E., & Young, J. (2002). Bridging research and policy: Context, evidence and links. ODI. Retrieved October 7, 2009, from http://www.odi.org.uk/resources/odi-publications/working_papers/wp173.pdf
- Dada, D. (2006). The failure of e-government in developing countries: A literature review. *The Electronic Journal of Information Systems in Developing Countries*, 26.
- Ensor, P. (2003). The national qualifications framework and higher education in South Africa: Some epistemological issues. *Journal of Education and Work*, 16(3), 325. doi:10.1080/1363908032000099476
- Gibbons, M., Limoges, C., & Nowotny, H. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies*. London: SAGE.
- Health Systems Trust. (2005). Health Statistics 2005: Health Personnel. Available at: <http://www.hst.org.za/healthstts/102/data>
- Hearn, G., & Foth, M. (2005). Action research in the design of new media and ICT systems. In K. Kwansah-Aidoo (Ed.), *Topical issues in communications and media research* (pp. 79–94). New York: Nova Science.
- Heeks, R. (1999). The tyranny of participation in information systems: Learning from development projects. Retrieved October 29, 2009, from <http://unpan1.un.org/intradoc/groups/public/documents/NISPAcee/UNPAN015538.pdf>
- Heeks, R. (2002). Information systems and developing countries: Failure, success, and local improvisations. *The Information Society*, 18(2), 101. doi:10.1080/01972240290075039
- Heeks, R. (2003). eGovernment for development: Success/failure rates survey overview. Retrieved January 6, 2008, from <http://www.egov4dev.org/sfoverview.htm>
- Heeks, R., & Bailur, S. (2007). Analyzing e-government research: Perspectives, philosophies, theories, methods, and practice. *Government Information Quarterly*, 24(2), 243–265.
- Hirschheim, R., & Klein, H. K. (1989). Four paradigms of information systems development. *Communications of the ACM*, 32(10), 1,199–1,216.
- Kallinikos, J. (2004). Farewell to constructivism: Technology and context-embedded action. In C. Avgerou, C. Ciborra, & F. Land (Eds.), *The social study of information and communication technology: Innovation, actors, and contexts* (pp. 140–161). Oxford: Oxford University Press.
- Moodley, S. (2005). The promise of e-development? A critical assessment of the state ICT for poverty reduction discourse in South Africa. *Perspectives on Global Development and Technology*, 4(1), 1–26.
- Mumford, E., & Weir, M. (1979). *Computer systems in work design: The ETHICS method*. London: Associated Business Press.
- Nowotny, H., Scott, P., & Gibbons, M. (2003). Mode 2 revisited: The new production of knowledge. *Minerva*, 41(3), 179–194.
- Pardo, T. A., & Scholl, H. J. (2002). Walking atop the cliffs: Avoiding failure and reducing risk in large-scale e-government projects. *Proceedings of the 35th annual Hawaii international conference on system sciences*, 1,656–1,665.
- Rabinovitch, J. (2004). *Transforming community practice: [Re]moving the margins*. Union Institute. Retrieved October 2, 2009, from http://web.uvic.ca/ocbr/assets/pdfs/JRabinovitch_dissertation.pdf
- Reason, P., & Bradbury, H. (2007). *The SAGE handbook of action research: Participative inquiry and practice*. London: SAGE.
- Rivett, U., & Tapson, J. (2009). The Cell-Life project: Converging technologies in the context of HIV/AIDS. *Gateways International Journal of Community Research and Engagement*, 2, 82–97.
- Smith, M. L., & Elder, L. (2010). Open ICT ecosystems transforming the developing world. *Information Technology & International Development*, 6(1), 65–71.
- Soefftestad, L. T. (2001). Aligning needs and means. On culture, ICT and knowledge in development cooperation. *24th information system research seminar in Scandinavia (IRIS-24)*, (pp. 47–60). Retrieved October 2, 2009, from <http://>

ENACTING OPENNESS IN ICT4D RESEARCH

- rmportal.net/library/content/frame/aligning-needs-and-means.pdf
- South Africa Department of Health (DOH). (2007). *South African national strategic plan for HIV/AIDS and STI 2007–2011*. Department of Health.
- Thompson, M. (2004). Discourse, “development” and the “digital divide”: ICT and the World Bank. *Review of African Political Economy*, 31(99), 103–123.
- Vaillancourt, Y. (2005). Democratizing knowledge: Research experiments based on university-community partnerships. Retrieved October 2, 2009, from http://www.fimcivilsociety.org/en/library/Democratizing_Knowledge.pdf
- Williams, R., & Edge, D. (1996). The social shaping of technology. *Research Policy*, 25(6), 865–899.
- Wilson, F. (1997). The truth is out there: The search for emancipatory principles in information systems design. *Information Technology & People*, 10(3), 187–204.
- Wilson, G. (2007). Knowledge, innovation and re-inventing technical assistance for development. *Progress in Development Studies*, 7(3), 183.
- Wood, R., Kaplan, R., Bekker, L. G., Brown, S., & Rivett, U. (2008). The utility of pharmacy dispensing data for ART programme evaluation and early identification of patient loss to follow-up. *Southern African Journal of HIV Medicine*, 9(2), 44.