Research Article

Considering Failure: Eight Years of *ITID* Research[1]

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Abstract

This paper examines 40 articles published in Information Technologies & International Development *between 2003 and 2010 to identify commonalities among projects that failed to meet some or all of their development objectives. We considered whether the selected papers articulated clear development objectives and whether baseline data were used to inform project design. We then evaluated two factors associated with how the development objectives were implemented: the development perspective (top-down vs. bottom-up) and the project focus (the technology vs. the community). Our goal was not to find fault with our colleagues or their work; rather, we sought to advance the debate about the effectiveness of ICTD initiatives. We conclude that top-down, technology-centric, goal-diffuse approaches to ICTD contribute to unsatisfactory development results. Careful consideration of development objectives, perspective, and focus is essential in all phases of an ICTD project, from design through deployment. Honest and comprehensive reporting of failure (and success) helps ICTD researchers and practitioners to focus on best practices in meeting critical development needs.*

1. Introduction

Information and communication technologies (ICTs) continue to be rapidly integrated into poverty alleviation and social development programs across the developing world in the continued hope that computer literacy, Internet access, and mobile phone usage will transform the lives and livelihoods of the world's poor. As Heeks and Molla have observed, "Billions of US dollars are invested each year by the public, NGO and private sectors in information-and-communication-technologies-for-development projects such as telecentres, village phone schemes, e-health and e-education projects, e-government kiosks, etc." (2009, p. 1).

Parallel to this substantial investment of money and interest in information and communication technologies for development (ICTD) is a corresponding increase in expectations of development "achievement" through planned ICT interventions and organic ICT adoption. The World Bank is on record in support of the transformative potential of ICTs: "ICT promotes innovation and can trigger fundamental economic transformation. Individ-

1. *An earlier version of this paper appeared in the* Proceedings of the Fifth International Conference on Information and Communication Technologies and Development, *Atlanta, Georgia, March 12–15, 2012.*

uals . . . are unleashing the potential of their human capital and creativity" (World Bank, 2011, p. 4; World Bank Group, 2012). The bank has backed its optimism that ICTs can reduce poverty, boost economic growth, and spur accountability with billions of dollars' worth of investment in such large-scale projects as the build-out of national broadband networks and other backbone infrastructure initiatives. High expectations are not limited to the World Bank and sector-level investments. Bhavnani, Won-Wai Chiu, Janakiram, and Silarsky (2008) speak both to the explosive growth in mobile phone ownership and coverage, and to the social and economic benefits that mobile telephony can provide to the rural poor. The GSM Association highlights studies demonstrating how mobile phones drive everything from "improvements in social links, the creation of social capital, improved market information flows and productivity, as well as increases in GDP and Foreign Direct Investment" (GSMA, 2008, p. 1).

Despite being designed and implemented with the best of intentions, most ICTD interventions fail. Some ICTD projects fail outright, some are unsuccessful at achieving their stated goals, and many founder in the field. For example, the World Bank's Independent Evaluation Group summarized much of the Bank's $4.2 billion spent on ICT efforts as "limited" and "largely unsuccessful" (2011, pp. vii–ix). Heeks (2002) estimates that developing country information systems projects have a failure rate near 80%. This estimate includes *total failures,* which Heeks defines as initiatives that are never implemented; those that are immediately abandoned; and partial failures, which involve the non-attainment of major goals or significant undesirable outcomes. We employ these interpretations of failure in our analysis of 40 articles published in *Information Technologies & International Development* between 2003 and 2010 to identify commonalities among projects that failed to meet some or all of their development objectives.

The definition and analysis of *failure* in ICTD is a complicated undertaking, in part because the multidisciplinary nature of our work includes a rich breadth of efforts, including interventionist ICTD programs, support for widespread mobile phone adoption, and prototype-centric field research. While the *ITID* papers we reviewed cover a limited number of projects, they represent activities ranging from the introduction of nationwide information systems to small-scale local interventions, to observational studies of ICT. This range of research scale and scope helped to frame our analysis.

The development community periodically examines "lessons learned" at conferences and symposia, in failure reports (Engineers Without Borders Canada, 2011), and at FAILFaires (FAILFaire, n.d.). At FAILFaires, ICTD colleagues and collaborators present difficult or surprising issues related to ICTD "failures" in a good-natured and congenial environment.[2] Our point is that, while there is no lack of documentation on failures, ICTD researchers and practitioners still do not appear to take full advantage of the fruits of our failures. We are not succeeding at learning from or embracing the lessons from prior research and experience. Best explains that "we have collectively failed to stand on the shoulders of those who have gone before us . . . The problem is not the failures. The problem is our failure to learn from the failures" (2010, p. 51). This lack of critical self-evaluation is common in emerging fields such as ICTD, but it is particularly problematic when community development itself is at stake. These 40 *ITID* papers contribute (intentionally or not) to the rich corpus of documentation and discussion into the kind of ICTD interventions that work best under complex developing country contexts.

We do not use the word "failure" pejoratively. We define it simply as the outcome of a case in which an ICTD initiative has failed to meet some or all of its objectives. We examined many facets of each project, seeking to understand where failure or problems might manifest. The resulting partial project critiques should not be construed as global critiques of either the projects or the persons involved.

We examine failure through three criteria: development objectives, development perspective, and development focus. We began by considering whether the selected papers articulated clear development objectives, such as a particular Millennium Development Goal. We also considered what metrics, if any, underpinned the pursuit of that goal, as

2. ICTD 2012 hosted a standing-room-only FAILFaire that featured presentations on how racism and religious beliefs can create roadblocks in research, as well as on an education initiative that foundered because of inconsistent student participation and interruptions in the school year.

well as whether baseline data were used to inform project design. We then considered two factors associated with how development objectives are implemented: 1) perspective (top-down vs. bottom-up) and 2) focus (was it on the technology or the community?). We used this second variable to consider whether the project favored technology centrism or community centrism, understanding that this choice is usually not binary. In technology-centric projects, technology is the starting point and design is typically externally conceived and complete before there is significant engagement with the developing community. These initiatives generally focus on the complexities and requirements of hardware, software, or systems that are generally conceived and developed in a laboratory or institutional setting prior to field deployment. Community-centric design, on the other hand, is led by community participants and based on the perspectives of the individuals who comprise the community. It calls for community input and recognition of local circumstances in the design and deployment of the ICT. The success of the ICTD project hinges on how the technologist translates this input into software and hardware. These initiatives give prominence to issues of social context, local culture, and other sociological and community-centered factors. When community development is the primary objective of the research or intervention, the needs of the community must be a priority in ICTD project design.

2. Related Work

To assist in understanding the complex dynamics involved in interventions designed to improve the quality of life in poor or underserved areas, we look to literature from the larger international development industry as a barometer. Criticisms of "Development with a capital D" flow freely through the work of Easterly (2006), Moyo (2009), and others who point out the ineffectiveness of top-down development efforts. The ICTD field faces the same set of questions, but with additional concerns: Technologists are often unversed in development literature, and technology is often viewed as a neutral, bias-free tool. Yet, as imbued with meaning as any object, technologies and their intrinsic value systems affect communities and social ecosystems. This concept is explored by Best (2010), Burrell and Toyama (2009), Heeks and Molla (2009), Hosman (2010), Tongia and Subrahmanian (2006), and Wade (2002), who discuss the "unanticipatable interactions" (Wade, 2002, p. 448) and incompatibilities of some ICT systems with developing communities. Hosman furthers this theme in her study of persistent macro-level mistakes and misjudgments in reviewing the failures of education technologies in developing countries. These include erroneous assumptions about what ICTs can and cannot accomplish, failures to produce ecosystems of technology adoption, and failures to plan for the large and long-term commitment necessary for project sustainability and societal change. We are reminded that "merely providing tech does not automatically create a need for it, nor does it foster a culture of use" (Hosman, 2010, p. 50).

Tongia and Subrahmanian write that "ICT4D is a wicked problem!" (2006, p. 202) that cannot be tested definitively—something echoed in complaints of lack of methodological rigor and the need for greater precision in ICTD reporting (Burrell & Toyama, 2009; Donner & Toyama, 2009; Dorflinger & Gross, 2010). Development economists Banerjee and Duflo (2011); Krishna et al. (2006); Collins, Morduch, Rutherford, and Ruthven (2009); and others have applied economic models and random trials to study development efforts, and have been able to uncover intransigencies and nuances of social mobility and poverty from this economic perspective. The ICTD research field could consider these models, although they are difficult to conduct and the results are not always or easily generalizable. ICTD researchers may also benefit from contributions from the field of behavioral economics, as well as such economic sociologists as Granovetter (1985), who elaborates on the significance of cultural contexts in social action. His interpretation of economic activity, as informed and grounded in concrete, ongoing, interpersonal relationships, adds to an understanding of the uptake and use of new technologies as embedded in social relations.

The close relationships among ICTD, "wicked problems," and failures are explored further with models that attempt to identify reasons for failure, such as Heeks' (2009) design-reality gap model. This is further expanded by Mengesha to include "indigenous techno-scientific capacity" gaps (2010, p. 35). Best and Kumar's (2008) discussion of critical success and failure factors investigates the sustainability of ICTD projects along social, financial, political,

institutional, technological, and environmental dimensions, as does Duncombe's (2009) compendium of "Concepts, Methods and Lessons for Practices." Management specialists and NGO (nongovernmental organization) administrators also contribute to our understanding of failure from a field-based perspective: Banga, Liesman, Meulensteen, and Wiemer's (2009) in-depth study, "Budgets, Batteries, and Barriers," investigates the relationship among financial, technical, and institutional barriers that prevent groups from implementing technology into field programs. Baumard and Starbuck (2005) ask why we continue to *not* learn from failures. Sitkin (1992) suggests we pursue intelligent failure, while Edmonson and Cannon (2005) promote an "offensive" approach to learning from failure through deliberate experimentation.

Science, technology, and society (STS) studies further inform this analysis. The input-process-output models of Rogers (2003) and DeLone and McLean's (2003) IS success model continue to provide a framework to explain the propensity toward technological/technology-centric approaches to ICTD interventions. "Ecosystem" approaches to ICTs that blend social and technological ICT elements are also relevant to the debate on technology context versus community context. Orlikowski and Iacono's seminal work on the information technology *artifact*—"those bundles of material and cultural properties packaged in some socially-recognizable form such as hardware and/or software" (2001, p. 19)—is relevant when researchers and users position technologies in myriad roles, including tools, representations, and proxies, or as parts of a larger societal network. Dourish also addresses macro-level design decisions in his plea to designers to account for the "flexibility with which [technology] will be put into practice" (2004, p. 64). While not specifically referencing developing communities, Dourish asserts that the "designer needs to focus on ways for the user to understand the tool and understand how to apply it to each situation" (ibid., p. 173), which can be all the more critical in human development initiatives. Likewise, while Sproull and Kiesler (1992) do not directly address developing communities, their work on *first-level deviation-reducing* effects of an ICT (the anticipated, technical, planned gains) and the difficulties in predicting *second-level deviation-amplifying feedbacks* (involving skills, behaviors, and ways of thinking) are uniquely appropriate in analyzing ICTD project outcomes. Mengesha blends these technical and social literatures in a review of a public health information system in Ethiopia as "a complex sociotechnical activity in which the social and the technical negotiate and evolve together" (2010, p. 46). It is these negotiations that underpin the three criteria used to analyze the ICTD projects examined in this paper.

3. Methodology

Our analysis considered ICTD research published in *Information Technologies & International Development (ITID)* over the course of eight years (between Fall 2003 and Winter 2010). In all, 40 peer-reviewed *ITID* papers, all but a handful of them research articles, were examined. These 40 studies describe projects in 59 countries. A small number of papers published as research articles or research reports did not have qualitative or quantitative findings, and thus could not be coded or analyzed. Two *ITID* "Notes from the Field" pieces (Alampay & Bala, 2010; Mascarenhas, 2010) were included in the analysis. *ITID* conference summaries, book reviews, and (with the two noted exceptions) notes from the field were excluded from the analysis. We examined research conducted by both academic researchers and practitioners. Interventions, implementation studies, and ICT use studies (where ICTs were already in place), including papers that used both primary and secondary data, were present in the sample. The majority of the implementation studies represented pre-adoption research. In this paper, we use the term 'article' as a general term for the research we studied.

We assessed projects based on three factors present in most ICTD research: development objective, development perspective, and development focus. For each project, we explored the extent to which these three factors influenced community acceptance of the project: factors that influence decision making at early phases of project planning are captured in the development perspective; development objectives influence project design; and the development focus reflects the researchers' approach to integrating technology into the community. Our classification system provides insight into features that cut across ICTD initiatives, regardless of scale, location, or technology.

Finally, we gathered commentary recorded by the

authors regarding unexpected results, as well as their reflections on user behavior related to project success or failure.

Development Objective: Macro-Level Project Goals

We began our analysis by investigating whether the published research could be directly linked to a specified development goal, including whether the research was associated with one of the eight Millennium Development Goals.[3] The development objective is a macro-level determination of the development project's intent and broad goals. Decisions related to the development objective are normally made at the early stages of project design.

Development Perspective: Mid-Level Approach to Project

We coded the selected papers for whether the relationship with the study community was top-down or bottom-up. While such determinations are rarely binary, for the purposes of this study, projects are grouped into either a *top-down* (generally initiated by the researcher or an institution) or *bottom-up* (generally initiated by the community) development path. We looked for evidence of whether a research project had a hierarchical (top-down) or grassroots, community-led (bottom-up) approach to development. The choice of development perspective set the spirit and tone of an ICTD study or project, and it guided the formation of relationships between stakeholders and researchers. Issues related to the choice of development perspective often arose at early stages of project planning and decision making.

Development Focus: Micro-Level Engagement with the Community

In our analysis, we considered *development focus* to be the primary iterative state, encompassing negotiations with the community, codesign of an ICT solution, and the point at which technology is installed and tested. We assessed whether the reported research was centered on the needs of a particular community (community-centric), or whether it appeared to focus on a technological solution to a perceived problem or set of problems (technology-centric). Technology-centric research places the ICT at the center of the intervention, giving prominence to interface features, design elements, etc. Community-centric research emphasizes and is responsive to community-identified needs. Projects of this type generally derive from a need identified first within the community; ICTs are then designed and implemented in response to that specific need.

In coding for the technology-centric/community-centric factor, we analyzed only intervention and implementation studies, not observational studies, as those did not involve the introduction of a technology in a developing community.

4. Results

This section summarizes the results of the analysis of development objectives, perspectives, and focus in the 40 *ITID* articles examined.

4.1 Specific References to Failure

The *ITID* literature reflects a healthy awareness of the stubborn challenges that can impede the successful implementation of ICTD projects. Of the papers examined, 70% (28 of the 40) referred to or reflected on some level of failure or unintended negative outcomes related to the use, uptake, or adoption of ICTs in developing communities. These failures and obstacles occurred during all phases of the projects: from decisions about design, to infrastructure and distribution issues, to point-of-use.

Some references to failure highlighted all-too-familiar challenges of ICTD interventions. In one instance, an education-technology project in rural Uganda suffered mundane but significant problems that included outdated donated, power-hungry computers and solar panels that toppled in the wind (Hosman, 2010). In "Warana Unwired," Veeraraghavan, Yasodar, and Toyama tested a replacement for a failed PC system for sugarcane management, because PCs were "overkill and cost too much to maintain" (2009, p. 81). In their study of the usefulness of telecenters in Colombia, Parkinson and Lauzon (2008) found that, while telecenters may be designed, funded, and staffed to provide livelihoods and equity access, they weren't used by

3. The eight Millennium Development Goals (MDGs) are to eradicate extreme hunger (MDG #1); achieve universal primary education (MDG #2); promote gender equality and the empowerment of women (MDG #3); reduce child mortality (MDG #4); improve maternal health (MDG #5); combat HIV/AIDS, malaria, and other diseases (MDG #6); ensure environmental sustainability (MDG #7); and develop global partnerships (MDG #8). For further information, see www.un.org/millenniumgoals

Table 1. Articles Referencing Millennium Development Goals.

MDG Goals	Number of *ITID* Research Articles
MDG #1: Eradicate extreme poverty and hunger	6
MDG #2: Achieve universal primary education	7
MDG #3: Promote gender equality and empower women	1
MDG #4: Reduce child mortality	0
MDG #5: Improve maternal health	0
MDG #6: Combat HIV/AIDS, malaria and other diseases	2
MDG #7: Ensure environmental sustainability	0
MDG #8: Develop a global partnership for development	1
No reference to an MDG	23
Total *ITID* Studies	40

the target population or for those development goals. Mengesha (2010) recounts that the result of an HIV/AIDs information system in Ethiopia was negative. In their study of ICT use to boost employment opportunities for young people, Mariscal, Gutierrez, and Botelho found that "ICT programs do not often produce entrepreneurs" (2009, p. 26) nor do participants' positive perceptions translate into employment. Richardson's (2008) investigation of educational reform in Cambodia provided a litany of reasons why national ICT policies can sometimes fail: The government resisted its own policy, there was no plan in place to train teachers, there was no community-level support, and a World Bank contract was canceled due to apparent corruption in Cambodia.

4.2 Development Objectives: Goals and Metrics

We found that fewer than half (43%) of the 40 research projects bore any relation to a Millennium Development Goal (MDG). Using the MDGs as a guide, six (15%) *ITID* research studies focused on efforts to eradicate hunger and poverty through agricultural initiatives. Seven (18%) *ITID* articles focused on education projects. None of the 40 *ITID* research articles analyzed focused on child or maternal health concerns (MDGs #4 and #5). Gender equality and women's empowerment (MDG #3), in terms of access to and use of ICTs, are also largely absent from this body of work. Few *ITID* research articles disaggregated ICT use by gender. Only one study out of the 40 reviewed, Sinha's (2009) observational study in Bhutan, had a specific gender theme. There were no implementation studies that focused exclusively on women's access to or use of ICTs. Articles related to ICTD and gender have been published in other venues (e.g., the ICTD conference series), but their absence from *ITID* is noticeable. Combating HIV and AIDS (MDG #6) is mentioned in two (5%) of the *ITID* research articles examined. Research directed at ensuring environmental sustainability (MDG #7), including ICTD research related to climate change, biodiversity and habitat loss, access to safe drinking water and sanitation, or improving the lives of slum dwellers, is not a topic of research in any of the 40 articles.

We found that 23 (57%) of the *ITID* research studies referred to development sectors that were outside of the MDGs. The majority of this subset of studies related to the role of ICT in the context of employment or livelihood activities (10 articles). Four (10%) articles made no reference to a development goal or a development sector.

4.3 Poverty Metrics

This coding category identified specific poverty metrics addressed by the projects, i.e., whether the project was designed to "move the needle" on issues crucial to human development. We pursued this line of inquiry because ICTD is fundamentally defined by its commitment to development. Furthermore, many ICTD initiatives have a social change agenda. Therefore, it seemed reasonable that ICTD researchers submitting their work to a technology and development journal would highlight how or whether their

project would address development issues (however defined). Poverty metrics are one set of tools used to discover and track changes in community conditions. An awareness of baseline conditions can help in both the design of the intervention and the outcome assessment.

Approximately 25% of the studies either collected primary data on local conditions or conducted baseline surveys. We found that some researchers explicitly referenced detailed, local-level poverty metrics, while other researchers referenced large-scale data, such as levels of foreign direct investment, national mobile phone penetration rates, or such metrics as the literacy rates of nearby countries, as justification for their studies. Some researchers made no such references.

Additionally, when considering a broad view of such metrics (e.g., unemployment rates, number of schools, availability of potable water, etc.), we found that fewer than half (45%) of the studies we reviewed incorporated poverty statistics of any kind as a rationale or basis for research design. Researchers routinely acknowledge the importance of baseline surveys, and many suggest that prior conditions be qualitatively recorded or quantitatively measured. However, local-level data were largely absent from the 40 studies published in *ITID* between 2003 and 2010, despite the availability of resources to help target improvements at the community level and analyze change. For instance, most large NGOs have monitoring and evaluation templates, and frameworks are available to evaluate projects under budget, time, and data availability constraints (Bamberger, Rugh, Church, & Fort, 2004).

4.4 Development Perspective: Top-Down or Bottom-Up

Despite the best intentions to collaborate across academic and user communities, multiple authors reflected on how the ICTD research environment became competitive and political, rather than collaborative (Mengesha, 2010; Richardson, 2008; Vasudevan, 2007). For example, the StoryBank project zeroed in on technical and social factors that lead to devices and content being "more hierarchically managed and controlled than expected" (Frohlich et al., 2009, p. 19). Problems of this type may be able to be mitigated by adjusting the development perspective from a top-down to a more bottom-up focus. or by attempting to create hybrid projects that blend top-down project execution with bottom-up practices.

The problems mentioned by these authors are not due solely to the choice of a top-down or bottom-up development perspective, but it does appear that, despite support from governments, some top-down projects suffered from a lack of understanding of community dynamics and community needs. Top-down support is often crucial to ICTD initiatives (Anokwa et al., 2009): Institutional funding provides critical momentum, academic collaboration can strengthen a project, and partnering with agencies can provide much-needed access and insight. Bottom-up development that seeks to serve a community need also has its perils: Long periods in the field may be required, and projects can be slow, demanding, diffuse, and potentially ineffective.

The majority of research articles we sampled displayed a top-down, push approach to development, some of which overlooked local context. Korsah, Mostow, and Dias' (2010) research on an automated reading tutor was a largely top-down project: This proof-of-concept study applied U.S. technology that was initially introduced for tests in Ghana and Zambia with no adjustments to U.S.-accented English or storylines. Local and regional accents appeared to clutter the ICT implementation, although the researchers ultimately concluded that local content would be "good," and that the technology showed promise. Dangwal, Jha, Chatterjee, and Mitra's (2005) study was similarly top-down. It was designed to test whether young people in Karnataka villages could teach themselves the meaning of Microsoft icons as a proxy for learning.

In contrast, Wagner, Daswani, and Karnati's (2010) mother tongue-learning software project blended a top-down approach with significant amounts of collaboration with the community—although they concluded that their results showed only marginal impact, and that ICTs did not provide a broad "magic bullet" for learning. Panchard, Rao, Prabhakar, Hubaux, and Jamadagni's (2007) study relied on user participation from local farmers to produce environmental information for a decision-support system, an experimental technology that the authors ultimately concluded had merit, although it faced hurdles of scale, availability, and affordability. While the Livestock Guru (Heffernan & Nielsen, 2007) was also a top-down, technology-

centric implementation project, the project incorporated a significant amount of country-specific livestock disease information. Digital Green (Gandhi, Veeraraghavan, Toyama, & Ramprasad, 2009) used a participatory process for content production and a locally generated video database. These studies confirm the merits of engaging the community. They also remind us that engagement does not guarantee "success."

4.5 Development Focus: Technology-Centric or Community-Centric

Of the 40 studies reviewed, 19 (48%) were primarily technology-centric, 13 (33%) were primarily community-centric, and eight (20%) were a blend of technology-centric and community-centric practices.

Technology-centric research, as is evident in many of the *ITID* research articles, shows that exciting and potentially breakthrough technologies are being tested in developing communities. On the other hand, some authors were remarkably forthcoming about how their technology-centric research design contributed to the ICT project failing to meet a need or a goal. Patterson, Sim, and Aiyelokun's ICT intervention can be considered a classic technology-centric failure: "We prototyped the wrong system and took it across the globe," and "[t]o the degree that our original application was useless in the field, we clearly failed to establish the right means of reaching our goal while working from afar" (2009, p. 76).

Examples of approaches that appeared community-centric included the work of Best, Smyth, Etherton, and Wornyo, which examined mobile phone use in postconflict Liberia. The authors contended that the process of postconflict development required "an adequate understanding of the current uses and meanings of mobile telephony in that environment" (2010, p. 93). Wagner, Daswani, and Karnati reached a similar conclusion in their mother-tongue project in Southern India: "ICT-based programs that do not pay sufficient attention to the language, cultural, and attitudinal needs of the individual are likely candidates for failure in the near term" (2010, p. 38). Pal, Patra, Nedevschi, Plauché, and Pawar highlight the importance of understanding the potentially disruptive impact that rapid technology infusion may have on a community. To mitigate that impact and avert failure, they propose "an incremental approach" (2009, p. 62) to introducing technology in classrooms, so as to not overwhelm novice technology users. They further advocate incorporating familiar and available "off the shelf" technology "instead of building new devices that require both expensive R&D and a greater threshold of arguing for adoption" (ibid.).

Community-centric approaches do not guarantee project success or failure. In some cases where the community was closely involved in the project and the ICT showed promise, external factors placed limits on successful project extension. For example, the article on the COMMONSense wireless sensor networks project (Panchard et al., 2007) summarizes many of the common challenges associated with the introduction of experimental technology and problems of scalability. The authors point out that it is difficult to talk about demonstrable gains because the technology is "not yet widely available on the market" (ibid., p. 64) and it is not clear that the cost/benefit analysis favors the investment.

A number of studies highlighted the extent to which technology does not always result in positive development outcomes, regardless of whether a community-centric or technology-centric approach is taken. These types of "failures" remind us that systems which appear to provide solutions can often be undercut by political, social, and economic dynamics lying outside the scope of the intervention (Graham, 2010; Vasudevan, 2007).

The importance of working closely with participants in developing communities to understand cultural nuances was stated in a number of research studies as a key factor that can positively affect ICTD outcomes. As was noted by Corbett and Keller (2004), participatory GIS and community mapping exercises widened the power gap in the community by benefiting the already powerful and further marginalizing the less-educated. Corbett and Keller's research also highlights potentially high-risk scenarios that can result from inappropriate introduction of ICTD projects, including open conflict, extortion, and sabotage. After witnessing anger, ill treatment, isolation, and resignation among community members, the authors perhaps understated the problems when they wrote that information systems "may heighten levels of disharmony" (ibid., p. 40). Similarly, Medhi, Sagar, and Toyama's (2007) study reminds us that PCs can engender fear and mistrust in novice users. Alampay and Bala's (2010) study on mobile money transfers for the "bottom of the pyr-

amid" in the Philippines revealed low usage due to "mental barriers" and lack of motivation among users. These examples reveal the importance of working closely with community members and participants to identify problems and potentially address them effectively with ICT. A nuanced understanding of community dynamics, gained in a collaborative, consultative environment, helps to ensure project success if the information feeds back into the initiative, which appeared to be the case in some, but not all, of the *ITID* research reviewed.

4.6 Other Results

Several other themes emerged from our review. First, many topics that can be considered important to developing communities were not mentioned in the *ITID* studies we reviewed, including climate adaptation and energy management, human rights and social justice issues, ICT access for persons with disabilities, and immigration and internal displacement. This is not an exhaustive list of social problems (in the developed or developing world), but the lack of published research in a highly regarded scholarly ICTD journal on these and other intractable problems was notable.

Furthermore, we observed that, between 2003 and 2010, *ITID* research was dominated by research conducted in India, where more than 30% of the research projects were located. Sub-Saharan Africa, as a region, comprised 42% of the sampled research. There were no projects from China or Russia, and only one from Brazil, despite data showing that these large, populous countries face complex development challenges. Studies from the Caribbean were absent. There were no studies from the Middle East, North Africa, or the Gulf states. Although the World Bank designates the Gulf states as high-or middle-income (World Bank Statistics, n.d.), such designations obscure the fact that significant portions of the population in those countries are educationally, economically, and opportunity poor. The lack of published research (in *ITID* and other development journals) from some regions may be a result of issues such as government or legal controls that restrict research, the lack of historic academic collaboration, or funding priorities that target other under-resourced regions of the world. We highlight the lack of geographic diversity in *ITID,* but this issue is beyond the scope of this meta-analysis.

5. Discussion

We recognize the difficulties inherent in comparing projects that span a wide range of intervention purposes and scales, and we are cognizant of the complications involved in analyzing projects across a variety of countries, populations, technologies, and timeframes. It was not our goal to conduct a comparative analysis, but to concentrate on features such as development objective, perspective, and focus that are common to any ICTD study, regardless of purpose or scale.

The range of studies reflected in the *ITID* literature raises a number of important points for researchers and practitioners to consider, such as whether the goal of an ICT intervention is to spur intensive or extensive use. Those questions are worthy of consideration, particularly at the early stages of a study, when the development perspective is being formed. Furthermore, the conflict between conducting ICTD research and achieving development goals remains an unresolved issue. Similar to concerns raised within HCI4D (Anokwa et al., 2009), field-testing prototypes and experimental technologies, while typical of the research cycle, do not necessarily dovetail with the goals of development projects that have sustainability and social change agendas. As is reflected in the *ITID* literature, the ICTD research community is not unified on how to harmonize the difficult and sometimes competing goals of conducting experiments, producing social change, and studying the phenomena of ICT use in developing countries. Because the distinction between "doing development" and conducting research (Anokwa et al., 2009) is not altogether clear, confusion can contribute to both less-than-successful technology interventions and ambiguous research. We suggest that a careful consideration of the study's objective, the perspective that guides the process, and the focus that informs the relationships among stakeholders can reveal the tensions between development and research.

The extensive use of prototype technology and the lack of permanent installation or adoption are particularly important when attempting to establish trust relationships between participants and the ICTD academics or practitioners with whom they interact (Anokwa et al., 2009; Sterling & Rangaswamy, 2010). The Global South is littered with the remnants of such projects, and communi-

ties are justifiably jaded. Given that ICTD implementation and intervention research projects (at least as represented in these *ITID* articles) are overwhelmingly proof-of-concept studies, long-term support should be factored into how researchers negotiate their relationship with communities participating in an ICTD study:

> The emphasis on conducting short-term research pilots, due to funding cycles and time constraints (including product development and academic deadlines), demands greater responsibility on the part of the researcher to set target community expectations about ICTD projects, especially those with an intervention agenda. (Sterling & Rangaswamy, 2010, p. 1)

The negotiations that took place between research teams and participants for the projects examined are unknown, but it is hoped that the researchers attempted to establish "a fair, moral and candid relationship with the community to set expectations" (ibid.).

The subtle interactions, both between culture and technology, and between user and technology, as discussed in the related works, are worthy of more attention. It is also important to study ICT integration processes with a more comprehensive understanding of how communities and individuals shape the use of—and are affected by—technologies. There is ample room for further research into alternative ICT uses and user experimentation, all of which contribute to ICTD "success." Further, we need to be cognizant of potential community or individual conditions that have to be met prior to "development" taking place, i.e., the psychological, economic, and sociocultural factors that must be in place at the start of a development initiative. Addressing these preconditions may reduce the high failure rates of these ICTD projects that collapse, are abandoned, partially or wholly fail to achieve their stated goals, or create significant negative unintended consequences.

We initially coded for adoption/non-adoption, a category that considered whether the research project had adoption as a goal, and whether the project was perceived to have achieved that goal. We found this to be an elusive pursuit, as the vast majority of initiatives were short-term, experimental introductions of technology into communities where the technology was imported, temporarily installed, and removed upon completion. While short-term field-testing often yields significant and actionable findings, it is not conducive to measuring shifts in development metrics or witnessing social change, as short-term interventions do not have time to be scaled-up or replicated. Furthermore, we note that non-adoption does not always constitute failure. Nonetheless, we encourage researchers to be explicit about whether adoption is a goal, and when it is, to report their findings and reflections on whether this goal was achieved.

Further, we were surprised that this set of *ITID* research studies referenced the Millennium Development Goals so rarely. This may suggest that ICTD interventions are not being designed to address a specific humanitarian goal as identified by the United Nations, but it also reminds us of the importance of understanding development as a process, not solely as a predefined goal. Additionally, the MDGs do not specifically focus on the relevance of ICTs to those priority problems in the developing world, which may discourage ICTD researchers from consulting the MDGs as they develop their research objectives. In the *ITID* research we studied, we did not find a consistent set of organizing principles or metrics that were used in lieu of the Millennium Development Goals.

6. Reporting Failures

Our original goal was to identify commonalities among projects that succeeded in facilitating future success. This goal proved difficult to achieve. We were better able to identify commonalities among failures and factors that potentially have a negative impact on an ICTD outcome. These factors were most evident in projects with highly top-down, technology-centric approaches. We applaud those research teams who were forthright (even fearless) in reporting their mistakes and shortcomings. Such honesty benefits the discipline as a whole by contributing to the knowledge base of both researchers and practitioners. Given the distressingly high failure rates in ICTD, reviewers in our field should seek to identify and promote the reporting of the most useful of these failures. An example of this approach can be seen in Best and Kumar's (2008) review of the challenges faced by the SARI telecenter project. The article identifies a trifecta of financial, institutional, and political failures that plagued the project.

Kothari, Pandey, and Chudgar's (2004) study confirmed that ICTD solutions often face paralyzing political barriers to their widespread installation and use.

These realities serve to remind our community to temper our ardor for technology, which sometimes reaches the point of "technological utopianism" (Toyama, quoted in Stross, 2010), or "techno-fetishism" (Best, 2010). These fantasies do not well serve either our discipline or the communities with which we work.

Acknowledging the significant difference between a small-scale proof-of-concept study (intervention) and the roll-out of nationwide ICTD programs, we believe there are important similarities among ICTD projects, regardless of intervention purpose and scale. These similarities concern the need for a more rigorous and disciplined approach to understanding "ground truths" within a country or community. Gathering relevant baseline data and engaging community members in the research agenda are ways to seek these "truths."

We view the high failure rate in ICTD efforts as being symptomatic of the complexity of working in a multidisciplinary domain in often difficult field conditions. We appreciate that mixed results are not uncommon in the challenging, high-risk/high-reward circumstances in developing countries (World Bank Group, 2012).

6. Conclusions

This *ITID* literature review aims to contribute to a deeper understanding of how information and communication technologies are chosen, designed, developed, and deployed to developing communities. We sought to discover potential linkages among development goals and outcome objectives, top-down or bottom-up development perspectives, and assumptions about the relative importance of community and technology that can affect a project's focus.

Our goal is not to find fault with our colleagues or their work. The goal of acknowledging and highlighting strengths and weaknesses in research and practice is to advance the debate about the usefulness of ICTD at a particularly important point in the history of the field, as the discipline shifts from what Heeks calls ICTD 1.0 to ICTD 2.0: "Where ICT4D 1.0 marginalized [the poor], allowing a supply-driven focus, ICT4D 2.0 centralizes them, creating a demand-driven focus" (2009, p. 29). Our retrospective examination of ICTD literature suggests that a predisposition toward "ICTD 1.0" endures in some areas of research. Admittedly, the papers chosen for publication in *ITID* do not represent fully the scope of research in the ICTD field, nor do they represent fully the quality of research in the field. Also, because the projects examined were all reported in one journal, any editorial positioning of that publication is necessarily reflected in its contents. While this analysis only considered research published in *ITID,* it may be useful to apply this framework to research in related venues. Future work might investigate whether development perspective, objective, and focus are relevant indicators of success or failure in other development areas. Additional lines of inquiry might center on applying this assessment to the larger realm of ICTD policy, as it is widely understood that policy-level decisions often play a significant role in setting the preconditions for success or failure. We did not specifically code for policy-level failures in this analysis, because such high-level considerations were generally outside the scope of research studies and technology interventions reflected in this corpus of *ITID* research studies.

As a result of our analysis of 40 *ITID* case studies, we conclude that top-down, technology-centric, goal-diffuse approaches to ICTD contribute to unsatisfactory development results. The growing investment in, and implementation of, ICTs in developing communities presents an opportunity to examine less-than-effective practices, including our collective mistakes and negative outcomes. The poor do not benefit when practitioners, agencies, NGOs, and governments "dump hardware down and hope magic will happen" (Trucano, quoted in Strom, 2010). Careful consideration of development objectives, perspective, and focus are essential in all phases of an ICTD project, from design to deployment. Honest and comprehensive reporting of failure and success can benefit both the ICTD research community and the communities participating in ICTD initiatives. ■

References

Abraham, R. (2007). Mobile phones and economic development: Evidence from the fishing industry in India. *Information Technologies & International Development, 4*(1), 5–17.

Agarwal, S. K., Kumar, A., Nanavati, A. A., & Rajput, N. (2010). User-generated content creation and dissemination in rural areas. *Information Technologies & International Development, 6*(2), 21–37.

Alampay, E., & Bala, G. (2010). Mobile 2.0: M-money for the BoP in the Philippines. *Information Technologies & International Development, 6*(4), 77–92.

Anokwa, Y., Smyth, T. N., Ramachandran, D., Sherwani, J., Schwartzman, Y., Luk, R., et al. (2009). Stories from the field: Reflections on HCI4D experiences. *Information Technologies & International Development, 5*(4), 101–115.

Bamberger, M., Rugh, J., Church, M., & Fort, L. (2004). Shoestring evaluation: Designing impact evaluations under budget, time and data constraints. *American Journal of Evaluation, 25*(1), 5–37.

Banerjee, A. V., & Duflo, E. (2011). *Poor economics: A radical rethinking of the way to fight global poverty.* New York, NY: Public Affairs.

Banga, K., Liesman, T., Meulensteen, A., & Wiemer, J. (2009). *Budgets, batteries, and barriers. PDA implementation issues for NGOs.* New York, NY: New York University.

Baumard, P., & Starbuck, W. H. (2005). Learning from failures: Why it may not happen. *Journal of Long Range Planning, 38,* 281–298.

Best, M. L. (2010). Understanding our knowledge gaps: Or, do we have an ICT4D field? And do we want one? *Information Technologies & International Development, 6*(Special Edition), 49–52.

Best, M. L., & Kumar, R. (2008). Sustainability failures of rural telecenters: Challenges from the Sustainable Access in Rural India (SARI) project. *Information Technologies & International Development, 4*(4), 31–45.

Best, M. L., Smyth, T. N., Etherton, J., & Wornyo, E. (2010). Uses of mobile phones in post-conflict Liberia. *Information Technologies & International Development, 6*(2), 91–108.

Best, M. L., Thakur, D., & Kolko, B. (2010). The contribution of user-based subsidies to the impact and sustainability of telecenters—The eCenter project in Kyrgyzstan. *Information Technologies & International Development, 6*(2), 75–89.

Bhatnagar, S. C., & Singh, N. (2010). Assessing the impact of e-government: A study of projects in India. *Information Technologies & International Development, 6*(2), 109–127.

Bhavnani, A., Won-Wai Chiu, R., Janakiram, S., & Silarsky, P. (2008). *The role of mobile phones in sustainable rural poverty reduction.* Washington, DC: The World Bank ICT Policy Division.

Burrell, J., & Toyama, K. (2009). What constitutes good ICTD research? *Information Technologies & International Development, 5*(3), 82–94.

Collins, D., Morduch, J., Rutherford, S., & Ruthven, O. (2009). *Portfolios of the poor: How the world's poor live on $2 a day.* Princeton, NJ: Princeton University Press.

Corbett, J. M., & Keller, C. P. (2004). Empowerment and participatory geographic information and multimedia systems: Observations from two communities in Indonesia. *Information Technologies & International Development, 2*(2), 25–44.

Dangwal, R., Jha, S., Chatterjee, S., & Mitra, S. (2005). A model of how children acquire computing skills from hole-in-the-wall computers in public places. *Information Technologies & International Development, 2*(4), 41–60.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9–30.

Donner, J. (2006). The use of mobile phones by microentrepreneurs in Kigali, Rwanda: Changes to social and business networks. *Information Technologies & International Development, 3*(2), 3–19.

Donner, J., & Toyama, K. (2009, August 16–22). *Persistent themes in ICTD research: Priorities for statistics and new modes of data gathering.* Paper presented at The 57th Session of the International Statistical Institute, Durban, South Africa.

Dorflinger, J., & Gross, T. (2010, September 7–10). *Mobile HCI and technical ICTD: A methodological perspective.* Proceedings of the 12th International Conference on Human-Computer Interac-

tion with Mobile Devices and Services, Lisbon, Portugal.

Dourish, P. (2004). *Where the action is: The foundations of embodied interaction.* Cambridge, MA: The MIT Press.

Duncombe, R. (2009). *Impact assessment of mobile phones on development: Concepts, methods and lessons for practice.* (Paper No. 39). Manchester, UK: University of Manchester, Institute for Development Policy and Management, Development Informatics Group.

Easterly, W. (2006). *The white man's burden: Why the West's efforts to aid the rest have done so much ill and so little good.* New York, NY: The Penguin Press.

Edmonson, A., & Cannon, M. (2005, August 22). The hard work of failure analysis. *Harvard Business School Working Knowledge.* Retrieved from http://hbswk.hbs.edu/item/4959.html

Engineers Without Borders Canada. (2011). *2010 failure report: Learning from our mistakes.* Toronto, Canada: Engineers Without Borders. Retrieved from http://legacy.ewb.ca/mainsite/pages/publications/EWB_2010_Failure.pdf

Esselaar, S., Stork, C., Ndiwalana, A., & Deen-Swarray, M. (2007). ICT usage and its impact on profitability of SMEs in 13 African countries. *Information Technologies & International Development, 4*(1), 87–100.

FAILfaire. (n.d.). *FAILFaire: Learning from #FAILs in ICT and mobiles for development.* Retrieved from http://failfaire.org

Frohlich, D. M., Bhat, R., Jones, M., Lalmas, M., Frank, M., Rachovides, D., et al. (2009). Democracy, design, and development in community content creation: Lessons from the StoryBank project. *Information Technologies & International Development, 5*(4), 19–35.

Gandhi, R., Veeraraghavan, R., Toyama, K., & Ramprasad, V. (2009). Digital green: Participatory video and mediated instruction for agricultural extension. *Information Technologies & International Development, 5*(1), 1–15.

Graham, M. (2010). Justifying virtual presence in the Thai silk industry: Links between data and discourse. *Information Technologies & International Development, 6*(4), 57–70.

Granovetter, M. S. (1985). Economic action and social structure: The problem of embeddedness. *American Journal of Sociology, 91*(3), 481–510.

GSM Association (GSMA). (2008). *The GSMA Development Fund Top 20: Research on the economic and social impact of mobile communications in developing countries.* London, UK: Author.

Hall, P., Ghimire, G., & Newton, M. (2009). Why don't people use Nepali language software? *Information Technologies & International Development, 5*(1), 65–79.

Heeks, R. (2002). Information systems and developing countries: Failure, success, and local improvisations. *The Information Society, 18,* 101–112.

Heeks, R. (2009). *The ICT4D 2.0 Manifesto: Where next for ICTs and international development?* (Paper No. 42). Manchester, UK: University of Manchester, Institute for Development Policy and Management, Development Informatics Group.

Heeks, R., & Molla, A. (2009). *Impact assessment of ICT-for-development projects: A compendium of approaches.* (Paper No. 36). Manchester, UK: University of Manchester, Institute for Development Policy and Management, Development Informatics Group.

Heffernan, C., & Nielsen, L. (2007). The Livestock Guru: The design and testing of a tool for knowledge transfer among the poor. *Information Technologies & International Development, 4*(1), 113–121.

Hosman, L. (2010). Policies, partnerships, and pragmatism: Lessons from an ICT-in-education project in rural Uganda. *Information Technologies & International Development, 6*(1), 48–64.

Jagun, A., Heeks, R., & Whalley, J. (2008). The impact of mobile telephony on developing country micro-enterprise: A Nigerian case study. *Information Technologies & International Development, 4*(4), 47–65.

Konstadakopulos, D. (2005). From public loudspeakers to the Internet: The adoption of information and communication technologies (ICTs) by small-enterprise clusters in Vietnam. *Information Tech-*

nologies & International Development, 2(4), 21–39.

Korsah, G. A., Mostow, J., & Dias, M. B. (2010). Improving child literacy in Africa: Experiments with an automated reading tutor. *Information Technologies & International Development, 6*(2), 1–19.

Kothari, B., Pandey, A., & Chudgar, A. R. (2004). Reading out of the "idiot box": Same-language subtitling on television in India. *Information Technologies & International Development, 2*(1), 23–44.

Krishna, A., Kristjanson, P., Kuan, J., Quilca, G., Radeny, M., & Sanchez-Urrelo, A. (2006). Fixing the hole at the bottom of the bucket: Household poverty dynamics in forty communities of the Peruvian Andes. *Development and Change, 37*(5), 997–1021.

Mariscal, J., Gutierrez, L. H., & Botelho, A. J. J. (2009). Employment and youth inclusion into the labor force via training in information and communication technologies (ICTs): The cases of Brazil, Colombia, and Mexico. *Information Technologies & International Development, 5*(2), 19–30.

Mascarenhas, O. (2010). Broadening the agenda for ICTs for poverty reduction: PICTURE–Africa. *Information Technologies & International Development, 6*(Special Edition), 37–44.

Medhi, I., Sagar, A., & Toyama, K. (2007). Text-free user interfaces for illiterate and semiliterate users. *Information Technologies & International Development, 4*(1), 37–50.

Mengesha, N. T. (2010). Sociotechnical dynamics in IS development in organizations: The case of a resource-constrained and competitive context. *Information Technologies & International Development, 6*(3), 33–50.

Micevska, M. (2005). Telecommunications, public health, and demand for health-related information and infrastructure. *Information Technologies & International Development, 2*(3), 57–72.

Miller, N. L. (2004). Measuring the contribution of infoplazas to Internet penetration and use in Panama. *Information Technologies & International Development, 2*(2), 1–23.

Mitra, S., Tooley, J., Inamdar, P., & Dixon, P. (2003). Improving English pronunciation: An automated instructional approach. *Information Technologies & International Development, 1*(1), 75–84.

Moyo, D. (2009). *Dead aid: Why aid is not working and how there is a better way for Africa.* New York, NY: Farrar, Straus and Giroux.

Orlikowski, W. J., & Iacono, C. S. (2001). Desperately seeking the IT in IT research: A call to theorizing the IT artifact. *Journal of Information Systems Research, 12*(2), 121–134.

Pal, J., Patra, R., Nedevschi, S., Plauché, M., & Pawar, U. (2009). The case of the occasionally cheap computer: Low-cost devices and classrooms in the developing world. *Information Technologies & International Development, 5*(1), 49–64.

Panchard, J., Rao, S., Prabhakar, T. V., Hubaux, J.-P., & Jamadagni, H. S. (2007). COMMONSense Net: A wireless sensor network for resource-poor agriculture in the semiarid areas of developing countries. *Information Technologies & International Development, 4*(1), 51–67.

Parkinson, S., & Lauzon, A. C. (2008). The impact of the Internet on local social equity: A study of a telecenter in Aguablanca, Colombia. *Information Technologies & International Development, 4*(3), 21–38.

Patterson, D. J., Sim, S. E., & Aiyelokun, T. (2009). Overcoming blind spots in interaction design: A case study in designing for African AIDS orphan care communities. *Information Technologies & International Development, 5*(4), 75–88.

Plauché, M., & Nallasamy, U. (2007). Speech interfaces for equitable access to information technology. *Information Technologies & International Development, 4*(1), 69–86.

Rangaswamy, N., & Nair, S. (2010). The mobile phone store ecology in a Mumbai slum community: Hybrid networks for enterprise. *Information Technologies & International Development, 6*(3), 51–65.

Richardson, J. W. (2008). ICT in education reform in Cambodia: Problems, politics, and policies im-

pacting implementation. *Information Technologies & International Development, 4*(4), 67–82.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York, NY: Free Press.

Sinha, C. (2009). Effects of education and ICT use on gender relations in Bhutan. *Information Technologies & International Development, 5*(3), 21–34.

Sitkin, S. B. (1992). Learning through failure: The strategy of small losses. In L. L. Cummings & B. M. Staw (Eds.), *Research in organizational behavior,* as cited by P. Baumard & W. Starbuck in *Journal of Long Range Planning, 38,* 281–298.

Sproull, L., & Kiesler, S. (1992). *Connections: New ways of working in the networked organization.* Cambridge, MA: The MIT Press.

Sterling, S. R., & Rangaswamy, N. (2010, December 13–16). *Constructing informed consent in ICTD research.* Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development, London, UK.

Strom, S. (2010, August 17). With humor, nonprofits review technology failures as learning experience. *The New York Times.* Retrieved from http://www.nytimes.com/2010/08/17/technology/17fail.html

Stross, R. (2010, April 17). Two billion laptops? It may not be enough. *The New York Times.* Retrieved from http://www.nytimes.com/2010/04/18/business/18digi.html?_r=0

Tongia, R., & Subrahmanian, E. (2006a, May 25–26). *Information and communications technology for development (ICT4D)—A design challenge?* Proceedings of the IEEE/ACM International Conference on Information and Communication Technologies and Development, Berkeley, CA.

Vasudevan, R. (2007). Changed governance or computerized governance? Computerized property transfer processes in Tamil Nadu, India. *Information Technologies & International Development, 4*(1), 101–112.

Veeraraghavan, R., Yasodhar, N., & Toyama, K. (2009). Warana unwired: Replacing PCs with mobile phones in a rural sugarcane cooperative. *Information Technologies & International Development, 5*(1), 81–95.

Wade, R. H. (2002). Bridging the digital divide: New route to development or new form of dependence? *Global Governance, 8*(4), 443–467.

Wagner, D. A., Daswani, C. J., & Karnati, R. (2010). Technology and mother-tongue literacy in southern India: Impact studies among young children and out-of-school youth. *Information Technologies & International Development, 6*(4), 23–43.

Walton, R., Putnam, C., Johnson, E., & Kolko, B. (2009). Skills are not binary: Nuances in the relationship between ICT skills and employability. *Information Technologies & International Development, 5*(7), 1–18.

World Bank. (2011). *World Bank information and communication technologies sector strategy.* (World Bank Approach Paper 2011). Washington, DC: World Bank.

World Bank Group. (2012). *ICT for greater development impact: World Bank Group strategy for information and communication technology: 2012–2015.* Washington, DC: World Bank.

World Bank Independent Evaluation Group. (2011). *An evaluation of World Bank group activities in information and communication technologies: Capturing technology for development.* Washington, DC: World Bank. Retrieved from http://ieg.worldbankgroup.org/content/dam/ieg/ict/ict_evaluation.pdf

World Bank Statistics. (n.d.). *Country overviews.* Washington, DC: World Bank. Retrieved from http://www.worldbank.org/en/country

Appendix 1. ITID *articles included in this analysis.*

The *Information Technologies & International Development* articles included in this analysis are listed below in alphabetical order:

Abraham (2007)

Agarwal, Kumar, Nanavati, & Rajput (2010)

Alampay & Bala (2010)

Best & Kumar (2008)

Best, Smyth, Etherton, & Wornyo (2010)

Best, Thakur, & Kolko (2010)

Bhatnagar & Singh (2010)

Corbett & Keller (2004)

Dangwal, Jha, Chatterjee, & Mitra (2005)

Donner (2006)

Esselaar, Stork, Ndiwalana, & Deen-Swarray (2007)

Frohlich et al. (2009)

Gandhi, Veeraraghavan, Toyama, & Ramprasad (2009)

Graham (2010)

Hall, Ghimire, & Newton (2009)

Heffernan & Nielsen (2007)

Hosman (2010)

Jagun, Heeks, & Whalley (2008)

Konstadakopulos (2005)

Korsah, Mostow, & Dias (2010)

Kothari, Pandey, & Chudgar (2004)

Mariscal, Gutierrez, & Botelho (2009)

Mascarenhas (2010)

Medhi, Sagar, & Toyama (2007)

Mengesha (2010)

Micevska (2005)

Miller (2004)

Mitra, Tooley, Inamdar, & Dixon (2003)

Pal, Patra, Nedevschi, Plauché, & Pawar (2009)

Panchard, Rao, Prabhakar, Hubaux, & Jamadagni (2007)

Parkinson & Lauzon (2008)

Patterson, Sim, & Aiyelokun (2009)

Plauché & Nallasamy (2007)

Rangaswamy & Nair (2010)

Richardson (2008)

Sinha (2009)

Vasudevan (2007)

Veeraraghavan, Yasodhar, & Toyama (2009)

Wagner, Daswani, & Karnati (2010)

Walton, Putnam, Johnson, & Kolko (2009)