Research Report

Expanding the Boundaries of HCI: A Case Study in Requirements Engineering for ICT4D

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Abstract

The rapid expansion of Information and Communication Technology (ICT) contributes to increasing the "digital divide" between the technologically rich and poor in a society, a divide that is correlated with socioeconomic wealth and poverty. By the term digital divide, we refer to inequalities in the abilities of people to use ICT to access information and services, and to benefit from them. As a way of building bridges, the field of ICT for Development (ICT4D) is given importance. The impact of sociocultural differences is a central concern when designing software applications for ICT4D. We argue that when current HCI practices focus too narrowly on the human-computer relation, they may only uncover surface-level manifestations of culture, leaving differences in deep-level manifestations of culture unexplored. However, differences at the deep level affect the meaning attributed to the surface-level manifestations, and may prevent end users from making meaningful use of ICT4D technology. To probe such differences that may occur anywhere in the designer-user-technology relation, we draw on Communications Theory to look at the modes of communication in use and the underlying deep-culture values they reflect, and we argue that HCI practice should expand its scope to consider the cultural aspects of communication. We support our argument with a case study in which we applied such an expanded HCI approach to address incongruence in mental models while designing a prototype database for use in a developing country.[1]

Introduction

Information and communication technology projects for development (ICT4D) seek to harness the potential of new and inexpensive communication technologies, such as mobile phones, to reduce disparities in socioeconomic conditions throughout the world. Due to the vast differences in the social, cultural, and economic contexts of local stakeholders and end users as compared to conventional software projects (Brewer et al., 2005), designing software for such projects poses unique challenges and requires a multidisciplinary approach. Because of its focus on people, *Human-Computer Interaction* (HCI) has come to the forefront of the ICT4D arena. *Software Engineering* is the overall discipline that addresses the engineering aspects of ICT4D projects, encompassing and integrating HCI. The role of *Requirements Engineering,* an important step in software engineering,

1. The name of the country in which this work was conducted is not presented to protect the participants' confidentiality.

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is to identify and deal with all the nonconventional constraints when defining system requirements. Here, integrating properties from standard software product quality models (ISO 9126-1, 2001) requires reassessing these properties in the novel context. For example, what does "maintainability" signify, and how it is realized when the nearest support center is a journey of several days away? Or what is "confidentiality" in an environment characterized by communal usage and shared facilities? We also argue for another disciplinary component, *Communication Theory,* to provide a more nuanced look at the influences of language and culture on such practices as computer use.

The goal of this paper is to expand the contours of HCI practice in ICT4D software projects. In a recent benchmark paper (ACM, 2008), HCI is characterized as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them." In the context of an actual software project, this broad definition can be constrained to the set of HCI practices and processes applied to achieve the property of "usability," with usability defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO 9241, 1998). User-centered design (ISO 13407, 1999) is an established process for achieving usability based on four principles (Gould, 1995): (1) early focus on users, (2) integrated design (prototyping), (3) early and continuous user testing, and (4) iterative design.

When applying HCI to engineer an actual software product, emphasis is placed on interaction between the software product and user, as well as on their immediate surroundings, while the larger social fabric in which they are embedded goes largely unobserved. While HCI offers a variety of theoretical frameworks for addressing this issue (cognitive theory, activity theory, situated action, ethnography, etc.), the considerable skill, time, and effort required to understand and apply such frameworks makes their practice problematic. Additionally, making such analyses relevant to the design is not obvious (Rogers, 2004). We argue that, in the context of engineering an ICT4D project, HCI practice can contribute significantly by illuminating the cultural practices associated with communication that precede human-computer interaction. Conventions of face-to-face discourse, paper records, and organizational structures all condition and form the basis for a community's ultimate interaction with computers. We argue for this expanded scope of HCI practice by presenting a case study in which we gathered requirements for a prototype database for the social works department of a small, English-speaking Caribbean nation. Our clients were novice users with no previous experience and a good amount of distrust of database information management systems.

We first provide an overview of the challenges of ICT4D. We then articulate the theoretical foundations underlying our approach to ICT4D as a function of sociocultural factors. We then present our case study, followed by an analysis of the benefits we noticed when we expanded the perspectives of HCI in the project under discussion. We conclude with applications for practice and plans for future work.

Challenges of ICT4D Projects

The term ICT4D is used to describe a wide range of endeavors with the common goal of promoting the socioeconomic development of disadvantaged communities through the direct or indirect use of ICT. These projects target marginalized populations with the goal of assisting them in improving their socioeconomic situation. Marginalization is correlated to a lack of social, economic, and political power, as well as to a lack of self-determination (Beardon, 2006). It may occur because of discrimination (women, the disabled, the poor, or the elderly) or location (underdeveloped regions or countries), or because of a lack of capacity (skills, motivation, know-how, and confidence) to fully benefit from the opportunities available in society. The prime drivers of these projects include stakeholders from the public, private, and nonprofit sectors, often, in the most effective instances, working in partnership (Ramirez, 2001; Tongia & Subrahmanian, 2006). The intended beneficiaries typically have limited schooling, low literacy levels, and low incomes, and they are typically underemployed (Parikh & Lazowska, 2006). The developing countries and regions where these projects take place are characterized by inadequate infrastructures, intermittent power and connectivity, extreme operating conditions (e.g., temperature, humidity, etc.), and underdeveloped economic markets and distribution and support networks, as well as by a lack of trained personnel. Although all ICT4D projects have these characteristics in common, the set of specific conditions and constraints that any particular project must address varies widely.

The projects themselves can take a variety of forms. ICT4D initiatives have three main thrusts:

(1) *developing infrastructure* to provide power, connectivity, and devices appropriate for the prevailing conditions in a sustainable manner;

(2) *building ICT capacity* corresponding to the skills and competencies necessary to maintain and use the technology; and

(3) *providing digital content and services.*

All three are essential for a project's success. With regard to stakeholders, most projects involve multiple stakeholders from different countries, disciplines, and sociocultural backgrounds. These include: (a) governments at both the local and national levels; (b) interested industries and businesses; (c) NGOs and other nonprofit organizations, including self-help groups and informal community initiatives; (d) international funding agencies; and (e) the targeted end users themselves. Regardless of whether these stakeholders are active or passive participants, each one brings its own agenda and set of objectives to bear upon the project.

Despite the best intentions, many ICT4D projects have failed to bring long-term, sustainable benefits to the communities in which they have been deployed. The following are among the reasons identified in the literature (Tongia & Subrahmanian, 2006; Unwin, 2009):

- Multiple stakeholders have vague objectives that do not necessarily converge, and there is little or no input from the ultimate beneficiaries.
- When ultimate beneficiaries are disconnected from project goals, they are unmotivated, distrustful, or unable to make use of the technology.
- Incomplete and unarticulated project objectives result in a lack of clear metrics for evaluating success, with the consequence that claims of success largely depend on individual stakeholder definitions.
- Deployment and sustained-operation constraints are inadequately addressed, with the result that many projects do not survive beyond the prototype stage once external support is withdrawn.
- Usability requirements and evaluations are inadequately reported, making it difficult to apply lessons learned to new projects.
- Requirements pertaining to economic sustainability are not considered, limiting a project's potential adoption and dissemination.

Early empirical studies established that providing access to technology alone was insufficient for a project's success. Also essential is the ability of people to make use of technology in order to sustainably engage in meaningful and gainful social activities (Warschauer, 2003). Thus, along with the technical success of an ICT4D project, it becomes necessary to also consider how that technology will be integrated into the broader social context where

it is to be deployed. According to the Unified Theory of Acceptance and Use of Technology (UTAUT) model,[2] to be accepted by its intended users, a technology must be perceived as beneficial, easy to use, and socially endorsed, and it must have an adequate infrastructure in place to support its use (Venkatesh et al., 2003). To meet these objectives, a technology must be relevant to the community's needs, expand on existing knowledge and skills, and be affordable and sustainable. To be part of a sustainable cycle, the benefits from the technology's use must balance the costs. Finally, for a project to be economically sustainable, it must produce a measurable outcome in a cost-effective manner, be scalable as the user population grows, and be maintainable after deployment (Koch & Caradonna, 2006). All these factors are necessary for the success of a software project, giving rise to the following key challenges specific to ICT4D projects:

(1) Success is to be measured by achieving sustained communal benefits that evolve over the long term, as opposed to short term. Metrics to measure the resulting benefits are difficult but necessary to show a compelling value proposition that justifies the investments needed to sustain a project beyond the prototype stage.

(2) Deployment and sustained operation constraints cannot be resolved from a purely technological perspective; they are dynamically interrelated to a community's broader socioeconomic context. For the technologies to be sustainable in communities where widespread poverty is the norm, innovative business models are needed, and those models' requirements must be incorporated into the projects from the beginning.

(3) There are major social, cultural, economic, and political differences between "technologically developed" and "technologically underdeveloped" societies that impact the effective and sustained use of ICT to make a lasting change; these differences reside in the social dynamics, as well as in the structural characteristics, of these societies.

An ICT4D project's sustained adoption is affected by multiple interrelated factors. Requirements engineering, deployment, and HCI all play important roles in determining how these factors converge, and the factors' interrelated and converging nature will in turn affect each discipline. The impact on HCI cannot be ignored and requires further investigation.

Sociocultural Differences and the Expression and Use of Information

ICT4D projects typically take place in underdeveloped countries and regions, making the practitioners' and local cultures key factors of ICT4D work. In the informatics literature, culture is variously described as: "shared ways of thinking, feeling, and reacting; shared meanings and identities; shared socially constructed environments; common ways in which technologies are used; and commonly experienced events" (Martinsons & Davison, 2007); and "collective programming of the mind which distinguishes the members of one group or category of people from another" (Hofstede, 2005).

Franklin (1990) describes culture as the set of socially accepted practices and values shared by a group of people, with practices described as "the way things are done." Practices are the observable manifestations of a culture expressed through symbols, artifacts, and procedures from forms of discourse, dress, and art to societal structures, methods, laws, and rituals. Values, in contrast, are largely unobservable, consisting of the set of knowledge, beliefs, norms of behavior, and ways of thinking that underlie the practices and give them meaning (Kersten et al., 2002).

Cultural differences are recognized as having a significant impact on software product and process adoption rates (Boehm, 2006). The majority of computer devices, software applications, and technology practices are developed and used by groups with an Anglo-American mindset. The export of these software products to other cultures has given rise to a growing body of research that examines cultural factors affecting software localization. A limitation of this research is its focus on the external manifestations, or "surface level aspects" of culture, such as language, currency, symbols, presentation formats,

2. The UTAUT model is derived by empirically comparing eight prominent models in the user acceptance literature, including Rogers' Innovation and Diffusion Theory (IDT) and Davis et al.'s Technology Acceptance Model (TAM). Based on the results, it synthesizes the most reliable predictors of technology acceptance and use.

conventions, standards, laws, and infrastructure, with inadequate consideration given to the deeper aspects of culture (Esselink, 2003; Kersten et al., 2002).

We argue that this neglect of deep culture by the computer science community impacts and restricts HCI practice in the ICT4D arena. This neglect is rooted in the underlying assumption prevalent within the software engineering community that cultural factors only affect the user interface, and that core functionality and logic are culturally neutral. We argue that this reductionist view of technology under-theorizes communication in the field of ICT. Information, seen as messages that have meaning within a given cultural context, circulates among members of a society, and the means of communication, together with the circulating messages, constitute the mindset and shared system of meaning within that society, referred to by Innis as the "cultural ecology" (Babe, 2000). As such, these messages cannot be made intelligible outside their cultural context simply by translating them to a new linguistic code; rather, they must be mapped (however imperfectly) onto meaningful concepts within the value system of the target culture. For this reason, Kersten et al. (2002) warn against the misguided view that *"all cultural aspects are encapsulated in the external layer of software"* (emphasis original), and can be localized simply by changing the user interface. Instead, software, like any other artifact of cultural information production, is culturally dependent (Bazerman, 1997). Thus, the role of HCI in ICT4D must move beyond the translation of informational material or the restructuring of user interfaces to support alternative forms of interaction, to consider how the information provided fits into the "cultural ecology" of that society.

When considering cross-cultural differences, a number of models have come to the forefront in the informatics literature. Hofstede's (2005) articulation of cultural dimensions (masculinity, power distance, individualism, long-term orientation, and uncertainty avoidance) is among the most frequently cited models, although it does have recognized limitations. Foremost among these limitations is the use of the nation-state as unit of analysis; the model's disregard of cultural differences that occur within or transcend national boundaries; its disregard of multicultural influences; and its view that culture is static over time, contrary to the now-dominant view in anthropology that considers culture as emergent and dynamic (Myers & Tan, 2003). Instead, we draw on Ong's theories of culture as a dynamic process, positioned along a continuum between orality and literacy, with the mode of communication conditioning how people accumulate, preserve, and share knowledge, and ultimately how they think and structure society (Ong, 2002; Couch, 1996; Babe, 2000). Ong's theoretical descriptions, strongly inspired by Havelock (1963), provide a more nuanced view that better explains the social phenomena observed at the individual and community level in our present case study. Although an analysis of the communication processes and semiotics would examine meaning, Ong's theories are better suited to our goal of exploring the inherent cultural differences in the designer-user-technology relationship.

Ong argues that an oral culture is, by nature, traditional, conservative, and situational. Traditional knowledge must be carefully conserved, as once it is forgotten or distorted, it becomes permanently lost. In the absence of written records, knowledge is embedded in the stories and practices shared by a community. These are preserved in communal memory, which is continuously refreshed by constant reenactment. Oral knowledge can only be transmitted through direct contact among community members. People must experience these stories and practices firsthand on a recurring basis if they wish to learn and recall them. In this way, knowledge manifests itself as concrete experience embedded within the social fabric of daily life. By necessity, such a culture is conservative, favoring continuity over experiment and radical change. Here, the collective has precedence over the individual, as it is the collective that embodies the shared experience that constitutes the pool of knowledge available to the community. At the same time, this pool of knowledge evolves adaptively, as that which is no longer relevant gradually passes from usage and is eventually forgotten.

By contrast, in a literate culture, knowledge can be permanently recorded. Society is free to experiment and innovate, as the original information can always be retrieved if the experiments are unsuccessful. As noted by Havelock (1963), such societies, by their natures, engender individualism, speculation, innovation, and change. When knowledge is recorded, direct contact is no longer essential, as information can be perused in asynchronous privacy;

Table 1. Traits and Tendencies of Experiential Versus Analytic Cultures.

Experiential Culture	Analytic Culture
Traditional	Experimental, seek novelty
Conservative	Seek innovation, change
Knowledge expressed through human action	Knowledge expressed abstractly
Shared, collective experience	Individual, subjective experience
Participatory, emotional	Detached, objective
High-context communication (context construed from shared environment)	Low-context communication (context explicitly stated)
Situated learning	Theoretical learning
Situational thinking with concepts drawn from concrete experience in operational frames of reference	Analytic thinking with abstract concepts organized in logical categories and lists
Thoughts expressed nonlinearly in additive grammatical structures using formulaic expressions, copious	Thoughts expressed linearly as "spatially" organized arguments, using subordinative structures, analytically sparse and precise
Live in the immediate present with time fluid and flexible—Hall's "polychronic" perception of time (1976)	Live in computed time managed linearly—Halls' "monochronic" perception of time (1976)
Collective has precedence	Individual has precedence
Social norms enforced by shame with respect to the collective	Social norms enforced by an individual's guilt with respect to laws

reading and writing are, in themselves, solitary activities. This injects an objective distance between the author and audience, allowing readers to form their own opinions, uninfluenced by live contact. In the absence of a shared environment, the context must be described with analytical precision, and abstract concepts are used to synthesize the knowledge embedded in concrete, day-to-day life experience. An analytic viewpoint is more conducive to reflection and speculation, opening the doorway for experimentation, which, when successful, generates change. At the same time, because knowledge is recorded, it is relatively static, and when change occurs, it is often disruptive.

Ong's original terms of "oral" and "literate" to distinguish these two worldviews can be somewhat misleading, as what they refer to is not the ability to read or write, but rather the extent to which a society has interiorized writing in its thought processes and the value it places on written as opposed to interpersonal sources of information. To avoid confusion in the discussions that follow, we henceforth refer to them respectively as *experiential* (i.e., grounded in a community's world experience) and *analytic* (i.e., derived from analysis and theorizing). These two should not be viewed as a dichotomy, as in fact, they manifest along a continuum, with diverse influences affecting different aspects of an individual's life—in constant flux. Table 1, derived from Ong (2002) and Couch (1996), briefly summarizes their characteristic traits and tendencies.

We are aware of the problems inherent in attempting to apply a descriptive model in a predictive fashion to anticipate how some specific subgroup of people will interact with a particular technology. Instead, we see this model as helping us understand the social context into which some technology will be introduced, as well as what cultural mismatches may exist within the three-prong relation of designer-user-technology.

Communication, Discourse, and Ways of Knowing

Our case study, described in a later section, provides what we believe to be a compelling example of the "cultural situatedness" of information. As discussed in detail below, we worked with the social service agency of a small Caribbean island to develop a prototype database system and the methods to use the information based on it. The purpose of any information system is to collect data about some topic of

interest with the goal of providing useful information about that topic. In this context, the computer serves as an intermediary tool to facilitate human-to-human communication. Database technology has its own internal logic, based on mathematical models, that assures such properties as data consistency, integrity, reliability, and so forth. At the same time, certain restrictions are imposed on the nature of the data and how it is entered. Generally, this underlying logic, which requires people to have a unique identifier, to spell names and other attribute values consistently, to enter data in a prescribed order, etc., goes unquestioned. While these aspects may seem trivial, in fact, they reflect the deeper cultural disconnects between the database and the users in terms of how they perceive and use information. In the case of the proposed database, we had to devise workarounds to support the users' current practices without compromising the technology's logic.

The Case Study Context

The country in question has a land area under 100 square kilometers and a population under 50,000, with a 98% literacy rate and a 24% poverty rate. Its primary languages are a local dialect and standard English. Its current administrative structure has evolved from its colonial past. The social work department is organized in a hierarchy, with the positions and reporting structure illustrated in Figure 1. Formal communication is indicated by solid lines, and informal communication is indicated by dashed lines. The social assistance section administers social protection programs (poor relief, food packages, medical care, home repairs, homecare, school uniforms, etc.), while the community development section administers programs such as vocational training, after-school programs, youth camps, etc. Within the social assistance section, the supervisor runs daily operations, with five officers reporting to her, and 18 homecare workers reporting to the officers. Each officer handles approximately 30 clients, and manages two or three homecare workers, who each assist approximately 10 clients. On the community development side, there are four officers who report to the director. Depending on the program, the development officers may work independently, collaborate, or be assisted by volunteers from the community or international agencies.

The department's operation is entirely paper-based, with the paper trail embedded in its work processes. On the social assistance side, the officers are responsible for processing requests for assistance and reviewing ongoing cases, both duly tracked on paper forms, and for writing quarterly reports on their activities. The officers primarily work in the communities, visiting clients in their homes to assess their situation. Once a week, they make the trip to the central office to discuss their cases with the supervisor and deal with paperwork. This involves completing the appropriate form for each case with a description of the problem, their assessment, and recommendations. This form is then reviewed by the supervisor before being passed on to the director for approval. On the community development side, the development officers submit project proposals, conduct development projects, and write quarterly reports concerning completed and upcoming projects. They primarily work in their respective areas, and they only come together for training, certain nationwide projects, or quarterly meetings.

While the academically trained director, supervisor, and community development officers can be considered professionals, the social assistance officers are lay practitioners. They have completed high school, but they have no formal social work training beyond what they have learned in the field or in departmental workshops. Nonetheless, they are dedicated to their work and well respected in the community. None of the homecare workers have completed high school. Computers are available in the department office and are used daily, primarily for email and word processing, as well as for limited Internet use. The social assistance officers share two or three computers in the office, but they have no access when they are in the field. Overall, department personnel have limited experience with computers and no experience with database applications.

The cultural embeddedness of conflicting attitudes toward data was apparent when observing the work practices of the lay practitioners. While they described their work of meeting with local clients as "paper based," the process was, in fact, better described as "narrative based"—the practitioners first listened to their clients' stories, and only later transferred the narratives to paper. When the practitioners went out into the community, they engaged in conversation with their clients and other community members about their concerns and

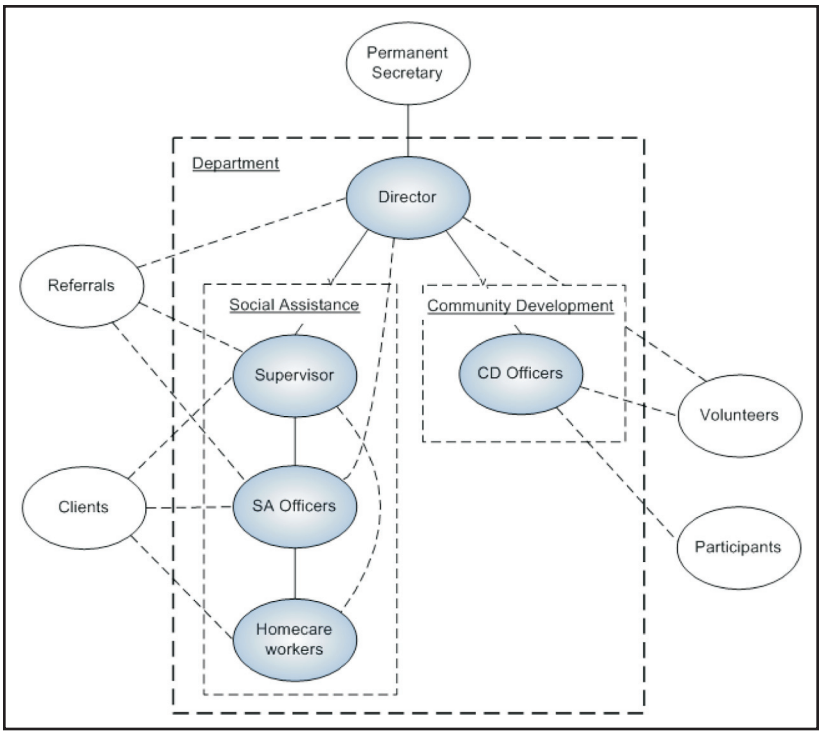

Figure 1. Organizational and Reporting Structure of the Department.

needs. Paper forms for recording the details of such encounters were left in the office, and we never observed any form of writing during the face-to-face interaction. In interviews, the officers spoke of the inconvenience of carrying these forms around (they might forget them, they felt no need to take notes, and it was easier to complete them once they were back at their desk).

What emerged from these observations was that the prospective users of the database engaged in work practices characteristic of experiential culture. People were not viewed in terms of unique numeric identifiers, but rather as embedded within a network of community relations. Interactions were characterized by factors such as high degrees of empathy and emotion, and by a sense of shared history and community values. Their justifications for not carrying the forms might have rationalized a tacit discomfort with pulling out pen and paper when sharing their clients' vivid stories of hardships. Writing may interfere with the emotionally engaging narrative, and could be better accomplished in the privacy of their office, even though taking notes would presumably increase the accuracy of remembered details. These features of experiential culture were central to both the work process and the type of information that circulated in the community.

Describing a social work client in terms of community and family relationships is quite different from describing him or her in terms of statistical data, a distinction that became crucial in the development of a culturally appropriate database. Taylor (2008) characterizes this distinction in the domain of social work as "showing" versus "telling." "Showing," with its analytical, objective distance is characteristic of a highly analytic society. It is the dominant form for expressing scientific thought, and it is compatible with the type of information available from a database. By contrast, in the "telling" mode, the narrator participates in the events described. It is the language in which personal emotions are expressed and affirmed with respect to community events and relationships, and it is characteristic of an experiential society.

Expanding the Scope of HCI

When designing software applications for ICT4D projects, most practitioners are aware of the critical importance of cultural differences. Because HCI deals with the human aspects of computer technology, these differences are generally examined from an HCI perspective, with emphasis on the input to and output from the computational elements, and on how these interactions fit into the broader context in which usage takes place. The HCI community has developed a rich repertoire of proven methodologies and techniques for doing this. To understand the users and the tasks they perform, ethnographic studies are generally used. Such studies consist of going onsite to talk with users and observe the

users' activities and behaviors related to the proposed system's functionality. This includes observing what supporting artifacts they use, as well as the environment in which the activities take place. These studies can be intensive in terms of both the extent of the interviews conducted and the amount of observations made. However, when these activities take place within the framework of an actual project, practitioners rarely have the time or resources to conduct comprehensive, in-depth analysis. Traditional ethnographic studies give place to "rapid ethnography" (Millen, 2000), with the risk that these lapse into "scenic fieldwork" (Dourish, 2006), characterized as "I went there and this is what I saw." Such studies risk revealing only the surface manifestations or practices of a culture, as the deeper cultural meaning may not be readily deduced. As we experienced in our case study, it may not be sufficient to listen to what people "say," but rather, to analyze how they say it to determine what underlying cultural values they are expressing.

Requirements engineering (RE) must consider cultural factors, as these have a direct bearing on the elicitation of system requirements. Both RE and the software engineering paradigm in which it fits are well-established disciplines with proven approaches for efficiently and effectively delivering quality software to meet specified requirements that satisfy stakeholders' needs. However, if stakeholders are unable to express their needs, or if practitioners misinterpret the needs that are expressed, then the project will fail before development has even begun. Here, along with looking at how communication affects the human-to-human relations in which the computer is an intermediary tool, it is also necessary to examine the designer-user-technology relationship. In the present case study of the database technology, it became evident that there was a disconnect between the intended purpose of the technology—to provide quantitative information characteristic of the "showing" mode—and applying it directly in a community where the predominant mode of communication is one of qualitative, socially situated "telling."

ICT4D projects deal with the delivery of information or services, both of which are communicative acts binding members of a community together (Babe, 2000). Members of communities that manifest the characteristics of an experiential culture will tend to express themselves using the "telling" mode, affirming their participation in the community. In contrast, members of communities with an analytic culture will tend to use the "showing" mode, injecting an objective distance in their discourse. In the context of ICT4D projects, this is relevant in two ways: (1) intended beneficiaries of ICT4D projects typically have low literacy levels, and consequently, they are likely to manifest many characteristics of an experiential culture; and (2) ICT4D software practitioners generally belong to highly analytic cultures, and thus a large disconnect is likely to exist between the mental models of the practitioners and local stakeholders. This mismatch may result in misunderstandings at a number of levels: It may affect (1) what needs users express, (2) how practitioners interpret those needs, and (3) how users integrate the information or service from the resulting system into their daily practices. In our case study, it affected all three. We contend that HCI practice should rise to this challenge and expand its focus to not only consider the user-to-computer interaction, but also to consider the cultural aspects of communication that characterize the human-to-human relations in the community and among the designer-user-technology relationship.

Case Study

In March 2008, we were approached by the national director of the social work department about the possibility of designing a database for client records. We, personally, were contacted because of previous collaboration in an unrelated field. The director's concern was that all client information was collected on paper forms, putting the department at a disadvantage when it came to obtaining external funding from developmental aid agencies. She also expressed concern about the usefulness and quality of the reports her social workers were generating from the paper forms. She expressed confidence that a database (like those used by her counterparts on larger islands) could provide the necessary quantitative information in a timely and comprehensive manner. To familiarize us with the type of information collected, she provided us with a complete set of blank forms used in the department and central to its work practices. Her assumption (as she later stated) was that this would be sufficient to design a database. This is the context in which our ICT4D project was initiated.

Although this project did not fit all our criteria for ICT4D (particularly regarding end users), it provided a crucible for testing our research ideas without the logistic complexity that ICT4D projects generally entail. We could focus on the cultural differences between technologically "developed" and "developing" societies, and the impact of these differences on requirements engineering without having to deal with language, technical, and infrastructural issues. Moreover, we had a motivated stakeholder in a relatively accessible location, making follow-up studies on sustainability and social impact possible.

Applying a standard RE approach, we began eliciting and documenting requirements with the director and supervisor through three two-hour telephone interviews and email over a three-month period. We identified the departmental problems to be addressed, the system goals, and the stakeholders and end users, as well as the system features, capabilities, and constraints. This was documented in a preliminary *software vision document,* detailing the nature of the problem and the scope of the potential solution. In June 2008, we made a one-week, on-site visit to elaborate the requirements, investigate the work context and conduct "rapid ethnographic" interviews. For two days, we met with all the stakeholders, both individually and with the workers as a group, to discuss the database and elicit their input. This was augmented with three days of observing stakeholders in the office and field. Based on this information, we developed a high-fidelity prototype database to assist with validating the requirements already collected and elicit further input. In September 2008, we returned for one week to get feedback on the prototype from the administrators and the lay practitioners. Having established that report content was central to introducing the database, we gave the lay practitioners a two-day workshop on report writing prior to presenting the database.

In the first phase of elaborating requirements, we investigated the types of reports to generate, the data required to generate them, and where that data would be obtained. We analyzed the paper forms and noted that certain attributes, for example, the names of a client's friends and extended family members or religious affiliation, were not data typically associated with a database. As including such data would make the database and data entry interface more complex, we questioned their inclusion, but were advised that the information was important and could not be omitted. We established that the database would primarily be used by the social assistance officers, who would enter information about departmental clients, and then use the data to draft quarterly reports. These reports would be used by the director to compose her own reports to departmental administrators, government officials, and granting agencies.

During our first on-site visit, we probed the purpose of the reports. The director was unfamiliar with specifying requirements and database technology in general. Nevertheless, she was largely able to "tell" stories, providing qualitative, compelling anecdotes about situations in which she needed particular information but was unable to get it. In contrast, both the social assistance and community development officers, although quite capable of talking about their work, were unable to acknowledge any practical value in the database, but instead saw it as a means of monitoring their productivity. In the case of the community development officers, we attributed their reticence to the fact that their work largely consisted of writing proposals and reports regarding community development projects and did not appear to be data-intensive.[3] On the other hand, we expected that the lay practitioners, who acknowledged that their work was data-intensive, would see the rationale for a database, and we were intrigued by their lack of interest. Why could they speak about their work, which, after all, was the collection of information about their clients, but not in terms amenable to the construction of a database that would collect and organize the information?

To better understand the way in which the lay practitioners worked, we analyzed the informational content of the completed paper forms, as well as the quarterly reports generated from the paper-based information. We noted that the quarterly reports contained detailed descriptions of client visits

3. We later established that the community development officers did have a data-intensive aspect to their work. However, at the time of the interviews, we were not aware of this, and they never mentioned it when describing their work.

and information about individuals, but little analysis of community needs. Furthermore, the recommendation section of the reports, which, ideally, should have advanced well-supported arguments for assistance programs, consisted of vaguely worded value statements (e.g., "We should decrease the isolation of the elderly"). We also found that the submitted paper forms were only partially completed; interestingly, the items about clients' religion and social connections were among those left blank. If these attributes were so important, why were they not being recorded?

The answer came from our field observations of the lay practitioners as they visited their clients. We observed that the lay practitioners did not bring departmental forms to their visits, and that no writing ever took place during the interviews, which were conducted like conversations. It was at this point that the deep cultural significance of the paper forms became apparent to us. The interactions between the lay practitioners and the clients were clearly rooted in the experiential mode of communication, with practitioners and clients conversing with high degrees of empathy and emotion, affirming their communal bonds. Here, the participants expressed their life experiences in the narrative, "telling" mode. In such a context, the purpose of the items on the paper forms identifying religion and circle of acquaintance became clear: they represented emotional and social resources for dealing with difficulties.

It appeared that the lay practitioners were working with two discursive forms: their work with clients in the community was coded in the "telling" mode of experiential culture, while their departmental writing tasks were in the "showing" mode of analytic culture. The paper forms contained a mix of significant items from the two worldviews, but only the fields relevant to the showing mode were filled in. Unaware of the differences (and to a large extent, the incommensurability) of these two discourses, the lay practitioners were unable to negotiate the demands of report writing, and they were likewise unable to express or imagine database needs. Their problem was thus a problem of human–computer interaction on the *deepest level*.

After the site visit, we developed the prototype database with a simplified dataset that did not include the unused attributes. The user interface is designed to be "situational" with respect to the paper files and work processes to which they are accustomed, with the paper form the guiding metaphor. While a full discussion is beyond the scope of this article, we briefly explain: The data-entry screens and available actions match the various forms in current use and associated activities, and they are situated in operational frames of reference (i.e., fill out blank forms, submit forms, review client files, etc.). Clients are referred to by name, and abstract concepts are presented in concrete terms (e.g., the concept "type of assistance" is realized by completing a particular form, rather than by selecting a value from a drop down menu classifying the different types available). Entries can be made in any order, and forms can be completed at later times. The resulting interface mirrors their current work practices more closely, but is less streamlined than if the interface were structured around the underlying domain model, depicted in Figure 2, with "client" the key entity (i.e., clients receive assistance, assistance is of different types, with tasks such as add new clients, assess existing clients, etc.). A sample screen shot is provided in Figure 3.

Following the principles of successful ICT4D engineering we developed in earlier research (Pitula & Radhakrishnan, 2007), we explored ways of making the database relevant to the lay practitioners' work. We re-examined the problems of user interface as a complex problem of human-computer interaction, and we sought ways to address the differences between the "telling" and "showing" modes of discourse. While the data-entry screens with free-form text fields such as "case notes" mirrored the paper forms in letting users "tell" about individual clients, the database reports could "show" things like how many clients have diabetes, total medical expenditures, and similar information desired by administrators. However, the practitioners did not include such data in their reports, nor did they see any use for it when "telling" about their personal experiences. We reasoned that reconciling this disconnect was crucial, as lay practitioners writing in the "telling" mode would continue to write reports of questionable quality, and would remain unable to envision use of the database. Our goal was to permit the practitioners to continue working in the narrative "telling" paradigm, while also enabling them to write reports that met the demands of the "showing" paradigm.

On our return in September 2008, prior to pre-

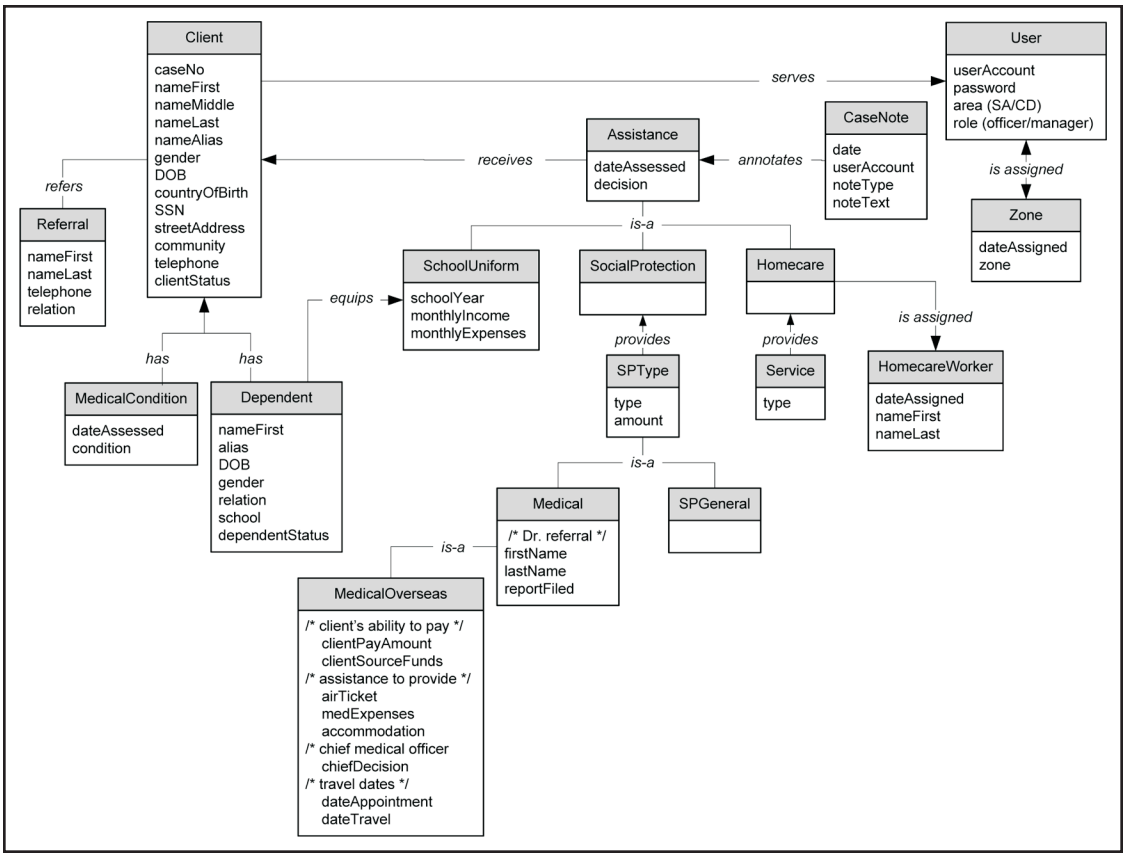

Figure 2. Prototype Domain Model.

senting the database, we organized a two-day workshop on report writing (Dysart-Gale et al., forthcoming) specifically designed to bridge the cultural differences between "telling" and "showing." As the lay practitioners were adults with no post-secondary education, the teaching approach was socially interactive, rather than intellectually reflective (Taylor et al., 2003). Our goal was to help the lay practitioners leverage the communication skills of experiential culture to engage the readers of their reports. By appreciating the writing process as a dialogue between writer and audience, the participants could develop the sort of arguments their superiors would find persuasive.

Without expressly mentioning the database, the first day of the workshop focused on the vaguely worded recommendations in the reports (e.g., "We must improve the diet of nursing home residents," "We must reduce feelings of loneliness among the elderly"). The lay practitioners viewed such recommendations as well written, and from the perspective of experiential culture, the recommendations were commendable statements of community values. However, the dominant "showing" mode privileged by their audience of supervisors, government ministers, and international funders required presenting the recommendations as actionable propositions supported with objective evidence. The lay practitioners were emotionally invested in the success of these recommendations, and they welcomed ideas about how to make them more persuasive to their audience. First, we focused on rewriting the recommendations as supportable positions. Then, on the second day, we concentrated on supporting the proposition with factual, objective evidence. The practitioners spontaneously identified the new database as a source for supporting their recommendations.

As an example of this process, the lay practitioners were concerned about misuse of a program

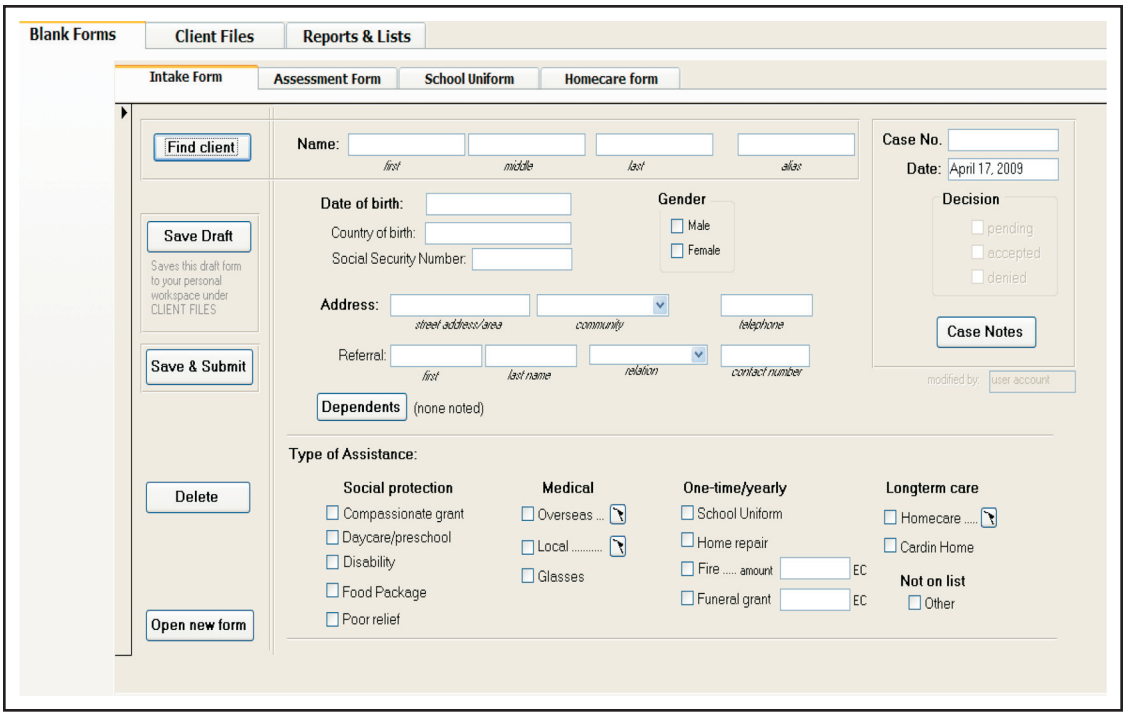

Figure 3. Data Entry Screen for a New Case.

intended to provide school uniforms for needy children. The practitioners asserted that some clients fraudulently obtained uniforms to resell at a discounted price. A proposed recommendation was initially formulated as: "Needy children in the community must be given school uniforms." While a laudable goal, this iteration provided no new call for specific action. After extensive discussion about their audience's expectations and needs, the lay practitioners reformulated it as a supportable proposition: "We must prevent the parents of ineligible children from receiving school uniforms." They reasoned that they would have to prove the existence of fraud to their audience, and then determined that this could be done by producing vouchers issued for children who were over- or underage, had left school, or were not dependents of the voucher recipient. Census or school records indicating a child's age and legal guardian would constitute acceptable evidence. As paper records, these documents were hard to locate, and they might have contained contradictory entries. In an electronic database, however, they would be readily available and consistent in their content.

Directly following the writing workshop, the lay practitioners were presented with the prototype database system. The purpose of this session was to validate our interpretation of the requirements collected during the previous visit and to elicit new requirements. The effect of the writing workshop was immediately evident. Whereas, before, the practitioners only saw the database as an alternative way to store data already available on paper forms, they now perceived it as a tool with the potential to facilitate and improve their work. They grasped its operation quickly, and immediately began proposing modifications and additional functionality to improve not only its information content, but also its integration within their work processes and the processes themselves. Their enthusiastic and eager engagement was a stunning reversal to their initial reticence and apprehension, reflected in these comments and requests: *"We need this now!", "Can we access it from the community centers [in the field]?", "Can we add notes [to forms]?", "Can it send us e-mail alerts?", "Why didn't you tell us this was what you wanted to do the first time you were*

here? We could have told you then and not wasted all this time!"

It could be argued that the social workers' reaction was triggered by having a tangible, working prototype in hand, as opposed to talking about some abstract system that they had difficulty conceiving. And certainly, a tangible prototype can contribute significantly in engaging stakeholders when eliciting requirements. However, this did not appear to be the sole reason for their change in attitude. In parallel to our work with the social workers, we worked with the community development officers in a comparable fashion, with the difference being that the community development officers did not receive training prior to being presented with the prototype. Their attitude toward the database did not change significantly between June and September. In contrast, the social workers went from viewing the database as a potential threat to their positions with no apparent benefit to seeing it as a valuable tool for advocating strong, actionable, measurable recommendations.

Communication Theory in ICT4D Projects

When examining the incompletely filled out client information on the paper forms, we referred to communication theory, in particular to that of Ong (2002). The theoretical construct of experiential culture enabled us to understand that data such as religious preference or names of close friends and extended family members were essential in determining a client's position within the community, and "telling" (Taylor, 2008) the client's story. This, we speculated, accounted for the stakeholders' insistence that such data be included on the paper form. However, when returning from their community visits and shifting from the "telling" (or experiential) mode to the "showing" (or analytic) mode, stakeholders neglected to note such information, perhaps tacitly understanding that it was not appropriate to the "showing" mode. Ong's theories were also useful in accounting for the vaguely worded recommendations in the written reports. Statements like "We must improve children's nutrition" are appropriate to the conservative rhetorical style of experiential culture, which seeks not calls for action, but rather, the affirmation of foundational cultural values.

While database technology is useful for storing data, its primary value resides in the ability to synthesize data into meaningful information concerning the topic area. Abstracting individual occurrences into totals, counts, and percentages is, in itself, meaningless unless these are interpreted in a broader statistical context to evaluate results, establish trends, plan, etc. Thus, in their purpose, databases embody the characteristics of an analytic culture, and they are geared toward the "showing" paradigm. Initially, stakeholders from an experiential culture appeared to view the database, with its statistical perspective, as a disruption of existing cultural forms, and they were unwilling to discuss their requirements for such a database. This initial resistance was overcome by the writing workshop. With regard to the administrators, although exposed to statistical discursive forms, they were unaware that this was the product of an analysis, and they expected the analysis to emerge fully formed as a product of the database itself. Thus, they were ill prepared to express abstract requirements, and instead, they "told" of concrete situations where they needed particular information.

Conclusion

This project is part of our ongoing research investigating the impact of sociocultural factors on RE in an ICT4D context. In the course of collecting requirements for the prototype database, we encountered a disconnect between wants and needs described in this case study. This disconnect manifested itself initially as upper-level administrators feeling pressure to acquire a database system like their counterparts on larger islands, without a clear idea of how their counterparts actually used the database in their daily work. Investigating this further from a communications perspective led to the discovery of the distinction between the "showing" and "telling" modes of discourse, and of the underlying values or "deep culture" they respectively reflect. In the case of the database technology, the "showing" paradigm embedded within it assumes an objective, analytical distance with respect to community, characteristic of an "analytic" society. In contrast, the "telling" paradigm embedded in the social workers' practices reflects participation in community, characteristic of an "experiential" culture. The incongruence between these two manifestations of deep culture could not be addressed by surface-level changes to the database system, such as modifications to the database schema or user interface, as these would not have changed the

nature of the fundamental problem. Instead, we bridged the disconnect by providing users with training in rhetorical styles that allowed them to reformulate their "telling" speech acts into "showing" ones more appropriate to the mode of communication favored by the database technology. In this way, they were able to see the value of the database and overcome their apprehension to integrate it into their daily work practices.

Currently, we are in the process of finalizing and delivering the prototype database to our client, with the intention of conducting a follow-up study in six months to determine whether the lay workers have truly integrated the artifact (database) into their work practices. As part of our ongoing research, and in conjunction with this project, we have elaborated a framework for characterizing experiential versus analytic cultures, as well as the markers by which they manifest themselves. In as-yet-unpublished work, we have applied this research to eliciting ICT4D project requirements directly from stakeholders in contexts where "telling" is the primary mode of communication. Thus, by expanding the boundaries of HCI, we are simultaneously expanding the boundaries of requirements engineering as well. The assumption underlying our work is that ICT4D software applications should grow organically from existing practices in the community instead of introducing radically new and disconnected practices, and that these practices and software applications should evolve together, driven by the stakeholders themselves.

> The task becomes less one of determining how we might get the user to operate according to our norms and modes of relating and becomes one of exploring ways in which the technology (and our relations) may better reflect the social organization which they have established and consider reliable. In the process of course we will all be changed. (Dr. W. Reimer, Concordia University, personal communication, November 21, 2007) ■

Acknowledgments

We wish to thank Dr. William Reimer of Concordia University's Department of Sociology and Anthropology for his time and invaluable insights into community development and technology. We also thank our anonymous reviewers for their constructive suggestions and critiques. Finally, we extend thanks to the many "stakeholders" involved in this project who gave us many joyous moments, and without whom this research would not have been possible. This work was funded through a Concordia University Vice President's Seed Funding Grant.

References

ACM. (2008). *SIGCHI curricula for human–computer interaction.* Available at http://sigchi.org/cdg/cdg2.html

Babe, R. (2000). The communication thought of Harold Innis (1894–1952). In R. Babe (Ed.), *Canadian communication thought: Ten foundational writers* (pp. 51–88). Toronto: University of Toronto Press.

Bazerman, C. (1997). Discursively structured activities. *Mind, Culture and Activity, 4,* 296–308.

Beardon, H. (2006). ICT for Development: Empowerment or exploitation? In H. Rahman (Ed.), *Empowering marginal communities with information networking* (pp. 44–61). Hershey, PA: Idea Group Publishing.

Boehm, B. (2006). A view of 20th and 21st century software engineering. *Proceedings of the 28th International Conference on Software Engineering (ICSE'06),* 12–29.

Brewer, E., Demmer, M., Du, B., Ho, M., Kam, M., Nedevschi, S., et al. (2005). The case for technology in developing regions. *IEEE Computer, 38*(6), 25–38.

Couch, C. (1996). *Information technologies and social orders.* Chicago: Aldine de Gruyer.

Dourish, P. (2006). Implications for design. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI 2006),* 541–550.

Dysart-Gale, D., Pitula, K., & Radhakrishnan, T. (forthcoming, 2011). Culture, communication and ICT for development: A Caribbean study. *IEEE Transactions on Professional Communication, 54*(1).

Esselink, B. (2003). The evolution of localization. *Guide to Localization.* Available at http://isg.urv.es/library/papers/Esselink_Evolution.pdf

Franklin, U. (1990). *The real world of technology.* Concord, Ontario, Canada: Anansi Press.

Gould, J. (1995). How to design usable systems. In

R. M. Baecker (Ed.), (2nd ed.), *Readings in human–computer interaction: Toward the year 2000* (pp. 93–121). San Francisco: Morgan Kaufmann.

Hall, E. T. (1976). *Beyond culture.* Garden City, NY: Doubleday.

Havelock, E. A. (1963). *Preface to Plato.* Cambridge, MA: Belknap/Harvard University Press.

Hofstede, G. (2005). *Cultures and organizations: Software of the mind.* New York: McGraw-Hill.

International Organization for Standardization (ISO). (2001). *ISO 9126-1 Software engineering: Product quality, Part 1, Quality model,* ISO/IEC, Switzerland.

International Organization for Standardization (ISO). (1998). *ISO 9241. Ergonomic requirements for office work with visual display terminals (VDTs), Part 11, Guidance on usability,* ISO/IEC, Switzerland.

International Organization for Standardization (ISO). (1999). *ISO 13407. Human-centred design processes for interactive systems,* ISO/IEC, Switzerland.

Kersten, G. E., Kersten, M. A., & Rakowski, W. M. (2002). Software and culture: Beyond the internationalization of the interface. *Journal of Global Information Management, 10*(4), 86–101.

Koch, J. L., & Caradonna, T. M. (2006). Technologies and business models that work in developing countries. *International Conference on Information and Communication Technologies and Development,* 193–202.

Martinsons, M. G., & Davison, R. M. (2007). Culture's consequences for IT application and business process change: A research agenda. *International Journal of Internet and Enterprise Management, 5*(2), 158–177.

Millen, D. R. (2000). Rapid ethnography: Time deepening strategies for HCI field research. In *DIS2000, Designing interactive systems: Processes, practices, methods, and techniques,* pp. 280–286.

Myers, M. D., & Tan, F. B. (2003). Beyond models of national culture in information systems research. In F. B. Tan (Ed.), *Advanced topics in global information management* (pp. 14–29). Hershey, PA: IGI Publishing.

Ong, W. J. (2002). *Orality and literacy: The technologizing of the word.* New York: Routledge.

Parikh, T. S., & Lazowska, E. D. (2006). Designing an architecture for delivering mobile information services to the rural developing world. *International Conference on World Wide Web (WWW 2006),* 791–800.

Pitula, K., & Radhakrishnan, T. (2007). A framework and process for designing inclusive technology. *Proceedings of the International Conference on Software Engineering Advances (ICSEA 2007),* 64.

Ramirez, R. (2001). A model for rural and remote information and communication technologies: A Canadian exploration. *Telecommunications Policy, 25*(5), 315–330.

Rogers, Y. (2004). New theoretical approaches for human–computer interaction. *Annual Review of Information, Science & Technology, 38,* 87–143.

Taylor, C. (2008). Trafficking in facts: Writing practices in social work. *Qualitative Social Work, 7,* 25–42.

Taylor, M., King, J., Pinsent-Johnson, C., & Lothian, T. (2003). Collaborative practices in adult literacy programs. *Adult Basic Education 13*(2), 81–99.

Tongia, R., & Subrahmanian, E. (2006). Information and communication technology for development (ICT4D)—A design challenge? *International Conference on Information and Communication Technologies and Development (ICTD2006),* 243–255.

Unwin, T. (2009). *ICT4D: Information and communication technology for development.* London: Cambridge University Press.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478.

Warschauer, M. (2003). Technology and social inclusion: Rethinking the digital divide. Cambridge, MA: The MIT Press.