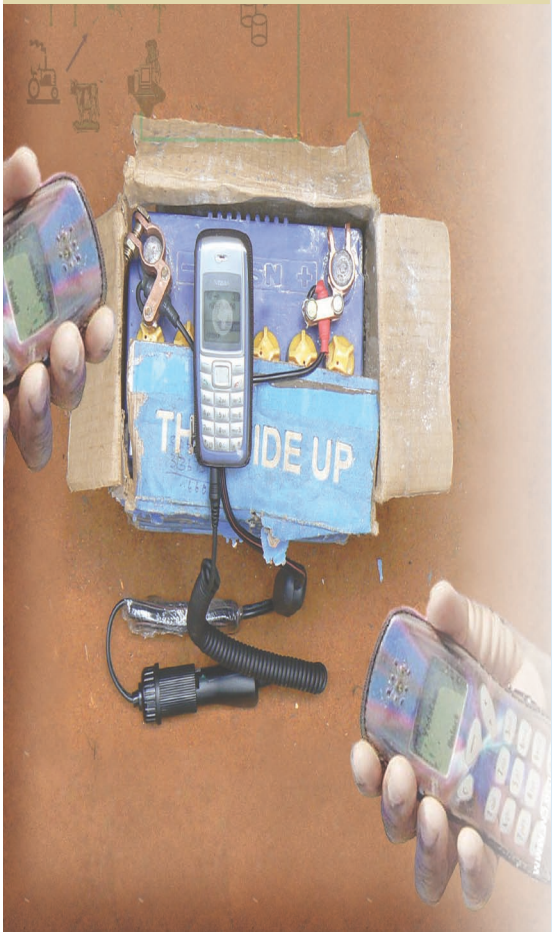

Information and Communication Technologies for Development

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ICTD has become a truly global undertaking, bringing together north and south, rich and poor, rural and urban, researcher and practitioner, technologist and social scientist—all striving to work toward a better life for the least privileged.

On a planet with 1.2 billion Internet users, a far less fortunate 1.2 billion people survive on less than a dollar a day. The same technology that has transformed our lives—the lives of the wealthiest people on the planet—remains out of reach and irrelevant for the poorest.

As if in sudden recognition of this stark gap, we have witnessed in the past decade an explosion in projects that apply information technology to support socioeconomic development. What is the value of a PC in a rural school? How do you design an interface that an illiterate migrant worker can use? Can computing technology have a positive impact on a farmer earning a dollar a day? These are just a few questions that scholars and practitioners have begun to explore with increasing creativity and ambition.

Often dubbed "information and communication technologies for development" and abbreviated ICTD or ICT4D, this field involves multiple sectors—governments, academia, small start-ups, large corporations, intergovernmental organizations, nonprofits, and nongovernmental organizations (NGOs)—and draws interest from multiple disciplines: anthropology, sociology, economics, political science, design, engineering, and computer science to name a few. As with many multidisciplinary fields, the boundaries are amorphous and the goals many, but we can nevertheless identify core components that define the field. To begin, let's consider the "D" or "development" in ICTD.

INTERNATIONAL DEVELOPMENT EFFORTS

The history of development as an international activity spans the past seven decades. Its roots can be traced to the final years of World War II, when the United Nations, the International Monetary Fund, and an organization that eventually became the World Bank were all formed. Post-WWII, the US put its energies into reconstruction through the Marshall Plan in Europe, as well as its occupation of Japan, in recognition of the need for politically independent and economically strong trade partners. Worldwide, former western

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European colonies regained their independence and set their sights on economic growth. At the dawn of the Cold War, the United States, the Soviet Union, and their respective supporters provided aid to Third-World nations to pull them away from the other's influence. These events laid the foundation for activities on a global scale that were intended to help poorer countries grow out of poverty.

Taken at face value, ending poverty and the correlated suffering is the intended goal of international development. The UN's eight Millennium Development Goals (MDGs), for example, explicitly seek to accomplish, among other things, the eradication of poverty and hunger, the establishment of equality between genders, and the provision of baseline healthcare and universal primary education by 2015. Of course, the MDGs are not a complete list. Other lists frequently include other objectives that consider shelter, water and sanitation, credit, and, increasingly, access to information. Although some might question whether information should be considered a fundamental human right, "access to information" has been one of ICTD's strongest slogans. This reasoning is often extended (with some debate) to imply the right to Internet access.

The idea of leapfrogging technology solutions played a key role in propelling ICTD forward.

INFORMATION AND COMMUNICATION TECHNOLOGIES

This brings us to the question of what constitutes ICT or "information and communication technologies" in ICTD. Taken literally, ICT can include everything from the printing press to Africa's talking drums; but in the context of ICTD, ICT has the connotation of modern electronic technology—the PC, the mobile phone, and the Internet play central roles.

In fact, the recent acceleration in ICTD activity owes much to the commoditization of the PC and the mobile phone. If there is a common thread, it would seem that ICT involves computing, either in the device or in "the cloud." (This is not meant to be an exclusive or binding definition, but rather an observation about the core of current activity.)

Other recent technologies, such as PDAs and wireless networks, are central to ICTD, whereas established technologies, such as TV, radio, and landline phones, while not excluded altogether, tend to be on the periphery. One reason for this is that interest in ICTD grew in the past decade due in part to the promise of the newer computing technologies; the idea of leapfrogging technology solutions played a key role in propelling ICTD forward. In this process, however, some researchers and practitioners have started to explore and discover new ways to apply established technologies.

Interdisciplinary design practices

With themes as broad as computing and socioeconomic development, the ICTD field is naturally highly interdisciplinary. Computer scientists and electrical engineers, of course, are integrally involved, and many projects explore how to extend the state of the art in computing to meet the challenges of the developing world. For example, networking must work in circumstances with low bandwidth, intermittent bandwidth, or no bandwidth at all. The challenges, however, frequently extend well beyond software and electronic hardware into more environmental elements such as dust, heat, water, and so forth. Thus, mechanical engineers and industrial designers might need to design waterproof packaging for sensor nodes or filters for dusty environments.

Social systems

Equally important are elements that concern the target populations—for example, cultural practices and beliefs, traditions, languages, literacy, and so on. Therefore, beyond engineering and the hard sciences, ICTD also involves social scientists in their capacities as observers of how people interact with technology, as well as designers of social systems that work alongside technology. Anthropologists and sociologists, for instance, might investigate how poor agrarian communities have taken to mobile phones and developed new patterns of usage that are not seen among wealthier communities. Economists or political scientists might propose policies for community radio that allow limited commercial broadcasts so that these projects can recover part of their operational costs. Because of their focus on something other than technology per se, social scientists offer a perspective that complements the engineering temperament.

Global organizational integration

ICTD has also involved multiple sectors. Governments and multilateral organizations such as the United Nations are, of course, directly involved in development. They have begun to explore ways in which the economic booms of the IT industry can benefit the poor. Nonprofits and NGOs have worked with poor communities for decades, and they are curious about how technology can accelerate their goals.

Perhaps more surprising is the engagement of the private sector. With corporate social responsibility dovetailing with the promise of emerging markets, the private sector is seeking its "fortune at the bottom of the pyramid" by exploring how products and services can meet the needs of impoverished households. In fact, some argue that business, being the engine of development, is the only means by which economically sustainable

change can occur. Finally, academics and researchers contribute both critique and innovation to this field.

ICTD has, therefore, become a truly global undertaking, bringing together north and south, rich and poor, rural and urban, researcher and practitioner, technologist and social scientist—all striving to work toward a better life for the least privileged. In this special issue of *Computer*, we present articles from four leading research groups in this important area of ICTD.

IN THIS ISSUE

Richard Heeks, a professor of development informatics at the University of Manchester, is one of the earliest scholars to apply an academic lens to information technology for development. He has been a consistent champion of the idea that technology must be applied with sensitivity to social, economic, and political contexts. In"ICT4D 2.0: The Next Phase of Applying ICTs for International Development," Heeks explores the evolution of ICTD and its transition to an emerging "ICT4D 2.0," arguing that the first phase was dominated by Internet-enabled PC telecenters catering to development causes that fell short of expectations, whereas the emerging phase is applying ICT much more creatively to development problems.

Balancing realism with optimism seems to be an essential characteristic for engaging and succeeding in ICTD work.

"Stages of Design in Technology for Global Development," written by members of the Technology for Emerging Markets group at Microsoft Research India, examines ICTD from the first-person perspective of the innovator. This article identifies five stages that researchers might experience in their quest for impact through technology. The early exuberance of the technologist almost always gives way to a realistic reassessment and adaptation. Based on their experience with ICTD projects ranging from agriculture to education, the authors underscore the important lesson that developing appropriate technologies and systems in ICTD requires paying constant attention to the real—not imagined—challenges poor communities face.

In "Toward Empowered Design," Gary Marsden, a professor in the Department of Computer Science at the University of Cape Town, discusses some of his group's work with mobile phones. Mobile phones are rapidly appearing in the hands of even some of the world's poorest people—in the past year, the number of active mobile phones in the world exceeded more than half of the world's population—and these users are hungry for personalization and customization to serve their needs. Thus, Marsden focuses his innovations on the mobile phone and "empowered design," as he works to create platforms rich enough to allow these users to design their own applications.

In "Deploying a Rural Wireless Telemedicine System: Experiences in Sustainability," the Technology and Infrastructure for Emerging Regions (TIER) group at UC Berkeley highlights the critical components for project sustainability in ICTD in the context of the group's flagship efforts to connect an eye hospital with its satellite rural clinics via long-distance Wi-Fi. Although the article includes summaries of the technical contributions, it emphasizes the requirements for social and economic sustainability. TIER was one of the first university initiatives in the US to begin a research program in ICTD, and the article provides an instructive critical analysis of what it took to make the group's best-known project a success.

Cross-cutting themes

While each article contributes a unique perspective on ICTD, several cross-cutting themes also emerge.

Multidisciplinary effort. First, the multidisciplinary nature of ICTD shines through in all of these articles. It's notable that while Heeks, a social scientist, discusses the anticipated technical contributions of the next phase of ICTD, the other three articles, written by computer scientists, emphasize elements such as human motivation, empowerment, and economics. Engineers are famous for carrying around the proverbial technology hammer seeking nails, or problems, to pound on. Yet, more often than not, the developing world presents hammer-wielders with screws, and this requires adaptation—not only adaptation of existing technology, but also adaptation of social structures and even research paradigms for those hoping to make a difference. For example, the articles from Microsoft Research and UC Berkeley include discussions of financial sustainability and the critical role of partnerships with local organizations. In both articles, it becomes clear that specialists are learning something of other disciplines, and they are finding it necessary to pay considerable attention to areas outside their expertise to have meaningful impact.

Economic sustainability. As Heeks emphasizes, the PC-based telecenter providing general public access to computing or the Internet appears to be waning in interest among ICTD researchers, despite its earlier status as the focal point of ICTD work and ongoing interest outside the academic community. For example, the government of India is set to roll out 100,000 government-supported telecenters, yet formal studies of the economic sustainability and socioeconomic impact of telecenters have found them wanting.

Indeed, none of the articles here considers the telecenter as a locus of innovation. In its place, the authors pay increased attention to innovations involving wireless

technology, mobile phones, and digital video, where the PC often lurks in the background. Marsden, for example, has restricted his portfolio of innovation almost entirely to the mobile phone, arguing that it is a technology for which both sustainability and impact are already evident.

Furthermore, all of the articles underscore the value of fitting technology into the existing social fabric, rather than creating new institutions to house the technology. New institutions are difficult to set up, and if a technology can work within the existing social structures, it's all the more likely that the community will embrace it.

Pull of opposites. A third trend to note is the constant pull of opposites in ICTD. On the one hand, developing countries present problems that are as diverse as the cultures they encompass, and the issues fully emerge only with direct interaction with the target communities. On the other hand, many of the issues are recurring, and they often are just minor variations of challenges encountered in the developed world. These contrasting poles are reflected in the realization and identification phases presented in the article from Microsoft Research.

Questions of cost also raise another apparent contradiction: For obvious reasons, it's desirable to decrease the cost of technologies and the infrastructure required to support them. UC Berkeley, therefore, has opted for a strict diet of inexpensive, mass-market technologies, with customization restricted to software and firmware; Marsden mentions "creative solutions using old hardware" and seeks to "leverage more out of existing platforms." At the same time, people seem to find the money to buy fancy mobile phones, and governments think nothing of spending millions of dollars on technology projects. In fact, in many communities, technology is an aspirational indicator of wealth and prestige.

The articles in this special issue share a cautious, self-reflective tone. The authors, speaking from hard-won experience, rarely make extravagant claims for themselves or their technology. Technology provides one piece in the larger puzzle of development, but rarely a total solution. Channels for information and communication might be lacking, but so too are a physical infrastructure, individual education, and social structure—all of which are typically required to accomplish meaningful change.

Despite the cautious tone, of course, none of the authors would be doing what they do unless they felt they could have eventual impact, and the articles all carry this optimism with regard to technology's potential to transform developing communities. Balancing realism with optimism seems to be an essential characteristic for engaging and succeeding in ICTD work.

We noted earlier that the history of international development dates back to the 1940s, and ICTD itself is a much more recent development. An alternate and equally valid interpretation is that the entire history of technology is one of socioeconomic development. The quality of life that most readers of *Computer* enjoy is possible only because of the great advances in technology. In this context, ICTD simply reiterates a commitment to make a difference in human lives through technology and systems. For those who are wondering how their talents could contribute to resolving the problems of the least fortunate in this world, we hope that the articles in this special issue will prod, provoke, and inspire. ■

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