

Special Section Illustrations by mwienerarts.com





Indra's Net: HCI in the Developing World

Susan M. Dray

Dray & Associates, Inc.
Minneapolis, MN USA

David A. Siegel

Dray & Associates, Inc.
Minneapolis, MN USA

Paula Kotzé

UNISA
Pretoria, South Africa

Introduction

There is a legend that once, long ago, a net was thrown over all the peoples of the world. This net had bells sewn on at every junction, so that the movement of any person in any place would set the bells jingling, reminding all people of their connection to each other. In the Indian version of this legend, this is Indra's Net—and instead of bells, it is jewels which are sewn into the net. When the net is moved, each jewel glimmers, reflecting the beauty of all. How fitting that, today, the net—this time the Internet—should now span the globe, reminding us of our interconnectedness with the world!

But for many in the so-called “developing world,” the Internet remains a distant or even unknown thing. Indeed, the technology and infrastructure that underlies much of the success of the “developed world” is all but nonexistent in many



places. For instance, in Africa, where the gap is probably the widest today, estimates for access to computers range from 1 in 130 [8] to as few as three per 1000 in sub-Saharan Africa [1]. Many of these computers are used by multiple people, but even so, optimistic estimates suggest that only 1 in 160 use the Internet [1]. Globally, Internet use is still “disproportionately white, educated and affluent” [1]. The gap in access to information and communication technologies (ICTs) between the developed and the so-called developing world is huge. Even within developing countries, the gap between the most affluent and educated (who can be as technologically “enfranchised” as the inhabitants of California or Germany) and the poor is enormous. And, despite efforts to address it, the disparity in Internet usage is increasing over time. Even though all countries, even the poorest, are increasing their use of ICTs, the world’s richest countries, the so-called “information-haves,” are increasing their use at much faster rates. At the same time, people in information-rich countries can afford to upgrade, expand, and develop additional skills with new technologies, further exacerbating the disparity. As a result, “the rich get richer and the poor get poorer” as the digital divide grows [2, 4].

So what does this have to do with us, as Human-Computer Interaction (HCI) professionals? Of course the digital divide is not simply a problem of human-computer interaction. It reflects profound inequalities in the distribution of wealth, educational opportunity, and technology infrastructure. However, initiatives to

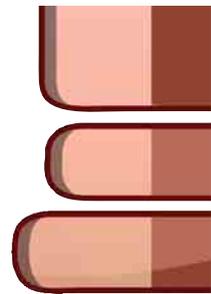
address the digital divide will have to also address those issues that are central concerns of HCI: How to improve the fit between technology, specific human needs, and human contexts; how to design technology to facilitate human interaction with it; and how best to manage the process of technology introduction.

Despite the small numbers of HCI people in the developing world, they are generating a large number of innovative ideas and important projects. As believers in and practitioners of user-centered design (UCD), they are acting as agents of change—empowering users in traditionally under-served or even unserved populations, finding ways to leverage this empowerment to expand the opportunities available to those whose voices are rarely heard, and having an impact on the future directions, not only of technology, but of their nations.

This special issue of *interactions* is devoted to sharing a small sample of the important HCI work happening in the developing world. The idea for this issue grew out of the Development Consortium for South Africa which took place at CHI 2002 in Minneapolis, chaired by Jacques Hugo and Theo Bothma. For this issue, however, we have expanded the focus to include colleagues from India, Brazil, and China. As we learned about these and other projects, we found a wonderful richness and diversity of experience.

The Complex Technology Landscape

While the digital divide is one important concern, it is not the only reason to be interested in and sup-



portive of HCI work in the developing world. HCI in the developing world is not merely about dealing with technological deprivation. For example, in the global economy, technologies originating in the developed countries are expanding into the developing world and need to be adapted to a wider range of users and situations than ever before. Exports from the developed world may not fit so well into the culture of other countries. They may need tailor-

and repair technicians. It is questionable whether the HCI community based in the developed world can ever obtain the necessary knowledge of local users around the world. We need HCI partners in the developing world to help us understand their special circumstances and their users.

The need for technology to work internationally is not limited to products exported from the developed world. Despite the persistent digital divide, the

We need **HCI partners** in the developing world to help us **understand** their **special circumstances** and their **users.**

ing of functionality, content, visual design, and/or overall interaction design to work in their users' contexts. We (Dray and Siegel) saw a fairly simple example of this when working with a client who produced a complex and sensitive system that integrated information processing with electro-mechanical peripheral devices. The engineers who produced this device were accustomed to working in a dust-free, climate-controlled environment, and envisioned their system being used in corporate or industrial settings, not too different from what they were familiar with. They discovered from international user studies that some of their customers were using their devices in tents in hot, dusty, desert environments, far from sources of replacement parts

evolution and proliferation of ICTs is in fact increasingly knitting together people from diverse backgrounds and contexts. As Derrick Cogburn discusses in his article in this issue, the people doing geographically distributed work in the global economy are linked by information systems, which must work for users from different backgrounds, cultures, and contexts. These systems must also take into account the needs created by the new social dynamics of distributed work.

Another technology trend, which Derrick refers to, is the growing international trade in services, including information services. Specifically, services and information systems which will be utilized by users in the developed world are being

designed and built in the developing world. This creates a number of challenges for the design and development process, challenges that HCI is particularly attuned to. For example, Pradeep Henry's article discusses the challenges of providing design input into software development projects being carried out in India for offshore customers. He also describes the approaches that he and his team at Cognizant have adopted to deal with such challenges, such as geographical dispersal of the team and geographical separation from users.

The dominant technology platforms, or the mix of platforms in use in different countries, or among different socio-economic groups within countries differ from what people in the developed world may assume. For example, many factors in some countries promote the adoption of less expensive ICTs, such as cell phones. In fact, in many or most "developing" countries, cell phone penetration far exceeds computer penetration. Therefore, HCI professionals may focus on different types of interface design and become specialists in the UCD challenges associated with these technologies, such as the very small displays on cell phones. Key advances in these domains may be very likely to emerge from the developing world. In this issue, Gary Marsden describes interesting work that his group at the University of Cape Town has done in this area,

In most
"developing"
countries,
cell
phone
penetration
far exceeds
computer
penetration.

responding to the importance of cell phone technology in the South African context.

HCI in Technology Initiatives for Indigenous Development

There are a large number of fascinating projects related to development of ICTs for indigenous use in developing countries, some of which we have learned about through our work on this issue. There

is a wide range of efforts under way to develop useful systems on a variety of platforms, such as kiosks, cell phones, PDAs and other handheld devices, as well as desktop computers. Interface paradigms that people in the developed world may take for granted may not be appropriate or workable for these projects. The result is a great deal of HCI creativity. The HISAAB project in India is developing computer systems to support village collectives engaged

in microfinance initiatives. It is a joint project of Media Lab Asia (MIT) and the India-based HCI professionals from Human Factors International. (Thanks to Apala Chavran for bringing this to our attention.) You can read about this project and their user-centered design activities at the two HISAAB Web sites listed in the References [5, 6]. For several years, Hewlett-Packard has supported what they call world e-inclusion projects aimed at using appropriate information technologies to foster economic



development [7]. For example, one of these, the Digital Garage, is a project in São Paulo, Brazil which teaches underprivileged youth how to use a wide range of computer equipment. In this environment, they learn from a team of technical experts who help them develop their own creative projects in a safe environment. Another, the Dikhatole Digital Village, will provide access and training in use of the Internet to residents of a township east of Johannesburg, South Africa [7,10].

These projects are often motivated partly or largely by the noble desire to use technology to advance social and economic development. The fact that they are aimed at groups that are so obviously disenfranchised technologically can put HCI on center stage in these efforts. When designing a system for a user group that has no computer experience and who may be marginally literate, it is hard to overlook the need for user-centered design (as is all too often the case when designers let themselves off the hook for bad design by relying on their users' presumed familiarity with similar systems). However, development projects motivated by "higher goals" such as general economic development, run the risks of all top-down design efforts, namely, that the goals of the sponsoring authority are often not the same as the more concrete and immediate goals of the end users. It is understandable that governments and

agencies would see technological development as an essential step in national development and as an inherent good, but we all know situations where "throwing technology at a problem" simply resulted in un-used systems, because the systems did not meet real users' immediate needs or did not fit the usage context. HCI has a crucial role to play in bridging the meta-goals of national development and the needs of actual users. Clarisse de Sousa, Raquel O.

Prates, and Simone Barbosa tell the story of how and why they had to introduce UCD approaches into a project that was a response to a national mandate.

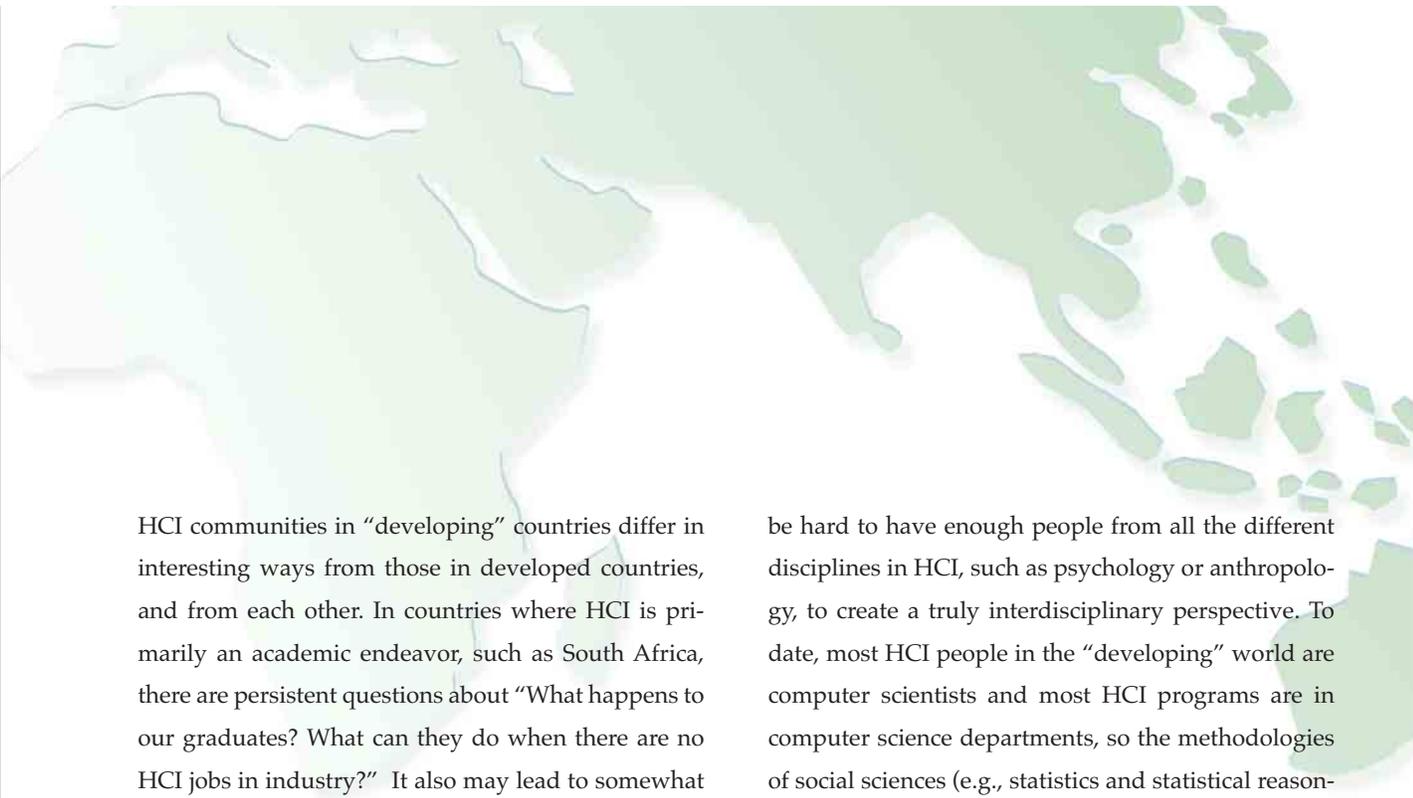
The Challenge of Limited HCI Resources

Many of us in HCI struggle with getting the ear of "the powers that be" in order to get into development processes at the right time to make a contribution to system design and

development. In many cases, we must educate developers, managers, or funding bodies, to make the case that a focus on the user is critical-and to illustrate how we can do this in time- and cost-effective ways to improve design. Most of us feel that there are not enough HCI people and not sufficient resources to have the full impact that we know we could and should have.

The challenge of resources takes on new meaning in the developing world. The demographics of the

HCI has a crucial role to play in bridging the meta-goals of national development and the needs of actual users.



HCI communities in “developing” countries differ in interesting ways from those in developed countries, and from each other. In countries where HCI is primarily an academic endeavor, such as South Africa, there are persistent questions about “What happens to our graduates? What can they do when there are no HCI jobs in industry?” It also may lead to somewhat more applied research being conducted in academic settings, as these researchers seek to balance their theoretical interests with the pressing “real world” needs of their countries. In other countries where there is not a strong academic HCI community, such as India,

be hard to have enough people from all the different disciplines in HCI, such as psychology or anthropology, to create a truly interdisciplinary perspective. To date, most HCI people in the “developing” world are computer scientists and most HCI programs are in computer science departments, so the methodologies of social sciences (e.g., statistics and statistical reasoning, experimental design, ethnography, etc.) are not as well known. This is an area where more open dialogue across boundaries—both geographic and philosophical—is important to support HCI community growth and development. The range of technology

HCI communities in the developing world are very small and may be isolated geographically from each other.

a very different set of questions arises including “Where can we get (more) training in HCI? Who can do the basic research needed to advance HCI in our context? How will we recruit and train additional HCI professionals? How can we get universities interested in this interdisciplinary area to build competence and excellence in HCI?”

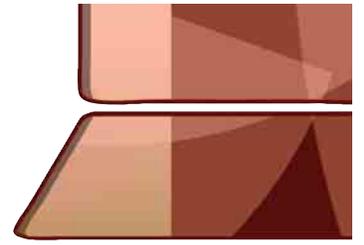
The issue of “critical mass” is an important one, since the HCI communities in the developing world are very small and may be isolated geographically from each other. HCI is an interdisciplinary profession and when there’s a very small community, it can

and interface issues that the HCI community addresses is huge, with tremendous cross-fertilization. This cross-fertilization can be more difficult to achieve in a small, geographically isolated professional community, as well.

These issues are addressed in the separate articles by Pradeep Henry and Jian Wang. Pradeep also discusses the efforts of the HCI group at Cognizant to maximize their impact with limited resources.

Diversity of Language and Mental Models

Although there are certainly similarities in the chal-



allenges we face, there are also many very significant and interesting differences which show up when you compare the research focuses between HCI in the developed and developing worlds, as well as how HCI in the developing world responds to the issues closest to home. Some examples of these have to do with research on language and mental models of non-western users. For many populations in these countries, many of the interface paradigms considered “standard” in the developed world simply are not applicable. Therefore, HCI professionals must adopt new and innovative approaches which are tailored to the resources and culture in which they work. By doing so, they may expand the envelope for everyone, including people in technology-rich locations.

Literacy and broader linguistics issues are examples of a research domain which is a “specialty” of developing countries. “Computer literacy” is not even the first challenge—the basic skill of reading is. Most user interfaces today require at least a basic grasp of written language. While this is a “given” in many “developed” countries, this cannot be assumed in most “developing” parts of the world. As recently as 2000, UNESCO estimated that more than half of young and adult populations in many developing countries are illiterate, with two-thirds of these being girls and women. Although this number has been declining in some regions, estimates are that almost 25 percent of the world’s population is still illiterate [9]. When we expand the concept of literacy to include computer literacy, the figures will be even less favor-

able. Obviously, interface designs that are based on assumptions about shared knowledge of standard interface paradigms are likely to fail, or reach only very limited audiences.

An example of innovative work on development of interfaces for non-literate users is provided by Edwin Blake and his group of the University of Cape Town [3], and also presented at the Development Consortium at CHI 2002. They worked closely with expert South African San (Bushman) trackers, developing a palm-based system for tracking animals, utilizing the trackers’ incredibly rich knowledge of animals and animal behavior. This device, called the CyberTracker, was developed in a user-centered, iterative design process, and was used experimentally in several South African wildlife conservation parks. Its design makes limited use of words, heavy use of images, and organizes information in a non-hierarchical manner. The CyberTracker has allowed the wildlife management and conservation community access to the skills and knowledge of these trackers, despite their functional illiteracy. This project has led not only to increased recognition for these trackers’ skills, but also to a more systematic and valuable utilization of these skills by the conservation managers of the national parks.

If we are to bring the largest number of groups into the technology revolution, we must recognize that there are profound differences among the world’s languages, at the level of how the structure of the language codes information. The languages

of the developed world do not provide a universal model. The field of natural language interfaces can only benefit from broadening the spectrum of languages we pay attention to. The article in this issue by Laurette Pretorius and Sonja Bosch gives an idea of the magnitude of basic linguistic research needed to develop language parsers for neglected languages, such as the Bantu languages. There are also profound differences among writing systems in different countries, which introduce challenges for text entry, and call for more specialized interface issues such as handwriting recognition. In his article, Jian Wang describes some of the work that has been done in China to develop methods for text input adapted to the Chinese ideographic writing system, in addition to giving an overview of the current state of development of HCI in China.

Differences in how languages structure information relate to differences in how people organize information mentally. This provides a natural bridge into the cross-cultural study of mental models. Obviously, differences in how people mentally organize their world are difficult to assess, and likely to be related to complex differences in culture, experience, education, environment, and common concerns. Identifying the user interface (UI) design implications of such differences may not only help in developing usable technology for more diverse groups, but may also ultimately help spur UI innovations. It stands to reason that research into this challenging area is likely to be

the most productive when we can learn about people from the most diverse backgrounds possible. Obviously, the developing world provides a fertile field for such work. The article by Marion Walton and Vera Vukovic in this issue comes out of this focus in HCI.

Final Words

There are many lessons to be learned here—for all of us in HCI, regardless of whether we live in Minneapolis, Munich, Montevideo, Mumbai, Melbourne, Mafikeng, or Mombassa. As editors, we have learned a lot from these authors, and we hope you share our excitement as you read of their insights and solutions to incredibly complex problems in HCI, and take away lessons for your own work, just as we did.

Technology can knit the world together or it can create a schism. HCI has a key role in bringing people together, no matter where they live. Since HCI professionals all over the world find themselves facing some of the same challenges, we can and must support and learn from each other, sharing the things which work for each of us, and suggesting alternatives that others may not have yet tried. The promise of HCI as a global endeavor is one reason that HCI in the developing world matters. But another is that HCI practitioners everywhere stand to learn from the efforts of their developing world colleagues as they respond to their particular challenges.



ABOUT THE AUTHORS



Susan Dray is President and David Siegel is Vice President of Dray & Associates, Inc., a user-centered design consulting firm. Their firm has worked in 17 countries, which has contributed to their international perspective on HCI.



*Susan was a keynote speaker at CHI-SA in 2001, and at the South African Institute of Computer Scientists and Information Technologists (SAICSIT) Conference in 2002. They have recently contributed a chapter on doing international usability research to a forthcoming volume tentatively entitled *Cross-cultural User Interface Design*, edited by Nuray Aykin, and scheduled for publication by Lawrence Erlbaum Associates in Summer, 2003. They are also co-editors of *Interactions' Business Column*. David and Susan both have Ph.D.'s in Psychology from UCLA. Susan is a Board-certified Human Factors Professional.*



Paula Kotzé is Professor, Head of Department of Computer Science and Information Systems, and Director for the Centre for Software Engineering at the University of South Africa. She holds a Ph.D. in Computer Science with specialization in HCI from the University of York (UK) and various other qualifications in Computer Science, Psychology and Education from institutions in South Africa. Her current interests include domain modeling of interactive systems (including formal mathematical modeling), user interfaces and authoring environments for e-learning, multicultural issues, as well as user interfaces for those with severe physical disabilities.

REFERENCES

1. Akst, D., & Jensen, M. "Africa goes online" Digital Divide Network, 2001. www.digitaldividenetwork.org
2. Anashin, V. "A worldwide view" in M. Tawfik, G. Bartagnon, Y. Courier (Eds.) "World Communication and Information Report, 1999-2000. Paris, UNESCO. Online at: www.unesco.org/webworld/wcir/en/pdf_report/chap12.pdf
3. Blake, E. A Field Computer for Animal Trackers. Presented at 2nd South African Conference on Human-Computer Interaction (CHI-SA2001). Pretoria, South Africa. September, 2001. Online at: www.chi-sa.org.za/CHI-SA2001/chisa2001New.htm
4. Bridges.org: Spanning the international digital divide. www.bridges.org/
5. HISAAB: Innovative Numeric Interfaces for Rural Microfinance, 30th August, 2002. www.medialabasia.org/
6. HISAAB: Grassroots Micro-Finance Management Software An Experiment in Numeric Interfaces, 2002. <http://hisaab.sourceforge.net/>
7. HP e-Inclusion Program, 2002. www.hp.com/e-inclusion/en/index.html
8. Jensen, M. "The African Internet-A Status Report," 2002. www3.sn.apc.org/Africa/afstat.htm
9. Maamouri, M. World literacy: What went wrong? The UNESCO Courier, March, 2000. www.unesco.org/courier/2000_03/uk/dossier/txt21.htm
10. UN Office for the Coordination of Humanitarian Affairs. South Africa: Bridging the digital divide and bringing hope, 2002. www.irinnews.org/report.asp?ReportID=28161

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without the fee, provided that copies are not made or distributed for profit or commercial advantage, and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on services or to redistribute to lists, requires prior specific permission and/or a fee.
© ACM 1072-5220/03/0300 \$5.00

A NOTE ABOUT TERMS:

We have used the terms "so-called developing/developed world" and "developing" world in this article interchangeably. We are aware that many in this part of the world find the term "developing" to be somewhat negative or pejorative, in part because it is sometimes used with value judgments of lesser worth by those in the so-called "developed" world. We are using the terms simply as descriptors, with no value judgment implied.