The Challenges of Emerging Economies

Mary Baker

RAJ REDDY: AFFORDABLE INFORMATION INFRASTRUCTURE IN EMERGING ECONOMIES

BAKER: There have been many discussions recently about providing inexpensive access devices in emerging economies, but what about the supporting infrastructure? How do you make that affordable?

REDDY: You can't ask people to pay directly for infrastructure any more than you can ask them to pay for the roads or water. However, you can provide them services they need, like entertainment, or communication, or education, or telemedicine. They pay for the service, and whenever they use it, the service provider pays a fee for the infrastructure. So if I download a movie, there's a charge for it, which might include a 10 percent tax for maintaining the infrastructure. If the government says, and the society says, that information infrastructure is as important as physical infrastructure, then the government ought to be responsible for it.

BAKER: Talking about pervasive computing, when viewed for the whole world and especially developing economies, one can ask, what do you mean by "pervasive"? Can I put something pervasive in a village? How will it work? Who would pay for it?

REDDY: The infrastructure we propose is that everybody should have

EDITOR'S INTRODUCTION

In this department we hear from two important voices in the area of pervasive computing for emerging economies.
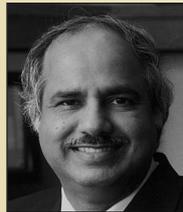
Raj Reddy is the Mozah Bint Nasser University Professor of Computer Science and Robotics at Carnegie Mellon University. He's a Centennial Fellow of the IEEE and an ACM Turing Award winner. He earned his bachelor's degree in civil engineering from Guindy Engineering College (now Anna University), his Master's of Technology from the University of New South Wales, and his PhD in computer science from Stanford University. He was the founding director of CMU's Robotics Institute and the dean of the School of Computer science from 1991 to 1999. From 1991 to 2001, he served as cochair of the US President's Information Technology Advisory Committee. In this interview I spoke with him about the affordability of the PCtvt—an information appliance combining a PC, television, videophone, and telephone for under $250 to bring ubiquitous information technology's benefits to the world's poor. More information about the PCtvt is available through the sources listed in the sidebar.

Genevieve Bell received her BA and MA in anthropology from Bryn Mawr College and her PhD in cultural anthropology in 1998 from Stanford University, where she wrote a history of the first nonreservation boarding school for Native American children in the US. Before joining Intel in 1998, she taught anthropology and Native American studies at Stanford. She's currently the director of the User Experience Group within Intel's Digital Home Platform. Before that, she spent seven years as a member of Peoples and Practices Research within Intel's advanced R&D labs. In that role, she conducted ethnographic research around the world, including fieldwork in seven Asian countries, encompassing 100 households in 17 different cities. She grew up in Australia, living in an Aboriginal community where her mother did anthropological fieldwork.

—*Mary Baker*

fiber, in every village everywhere in the world. Now you say, that's too expensive. Surprisingly, it turns out not to be.

We did a study for the World Bank about putting fiber into all the populated areas (at least 100 people per

square mile) of Africa. We looked at connecting all the capital cities and populated areas, putting fiber along the roads and rivers, and putting up Wi-Fi towers. You're able to cover between 80 to 90 percent of the population. For the nomadic population and desert regions, you still have to get other kinds of coverage. But near any populated area with 5,000 to 10,000 people, you'll get coverage, and it will be fiber/Wi-Fi coverage. That means you have essentially unlimited bandwidth.

How much does it cost? It turns out to be US$1 per capita. There are a billion people in Africa. So, for the digging, trenching, putting in 24 pairs of fibers at a depth of three or four feet, and lighting it up, plus the towers for Wi-Fi, the cost is only a billion dollars.

Why? Because the cost of labor is so cheap. In the US, to dig a trench and put in the fiber costs $100,000 per mile. In Africa it's $5,000 per mile, of which over half of the cost is the fiber itself.

A dollar per capita for unlimited bandwidth, and it will last for 50 years—it's maybe $20 per year per village of 1,000 people. So we're not talking about a lot of money. However, it has to be maintained. And there are also lots of existing infrastructures, telephone networks and so on, that have bought equipment that's 10 to 100 times more expensive than a pure-play IP network. These somehow have to be paid back or the government has to subsidize them, or some such. So there are lots of regulatory and legal and policy reasons this infrastructure might not happen. But there's no technical reason it can't happen.

Currently in India there's a lot of dark fiber. The model I proposed is to charge for the services and let them use unlimited bandwidth. Instead of DSL, which gives you 2 Mbits, suppose you have gigabit (Ethernet) bandwidth? Do we need a Gbps bandwidth? It turns out that for most of us, when we need it, we need it if we can afford it. The rest of the time we won't use it. Statistically speaking, it won't be that much bandwidth overall.

FURTHER INFORMATION ON THE PCTVT

R. Reddy, "PCtvt: a Multifunction Information Appliance for Illiterate People," www.rr.cs.cmu.edu/pctvt.ppt.

E. Vonderheid, "Reddy Applies Technology to Help Ordinary Folks," *The Institute*, 6 Dec. 2004; www.theinstitute.ieee.org/portal/pages/tionline/legacy/inst2004/dec04/12w.mempro.html.

R. Reddy, "Sustainable ICT for Emerging Economies," presentation at the NSF-UN-World Bank Conf. Technologies for Sustainable Development, 2004; www.rr.cs.cmu.edu/ITSD.ppt.

BAKER: What about the computer or appliance people will use?

REDDY: The question is, can the people use a computer? Most of the current content and the interface are in English, and therefore the first step is internationalization of content and the interface. But even if it is in a local language, at least a billion, maybe two billion, people might not be able to read, or if they can read individual words, they can't make sense of the sentences. But they do understand speech. So you need a computer that would speak to them and listen to them and then do their bidding.

This is where pervasive and mobile computing come in—new platforms. We're all betting that ultimately there will be a fusion of cell phones and PCs. And the basic form factor will be like the Blackberry or a Palm, maybe with a bigger screen, maybe with a little LCD projector. There are all sorts of possibilities.

The platform will be small and mobile, and the cost currently might be $200 or $300 to make, maybe $500. But ultimately it will come down, in quantities of a million units at a cost of $20 to $50 dollars per unit.

BAKER: It's happened to cell phones.

REDDY: Use the cell phone as an example. It already has a display, input and output, a keyboard, a processor, a camera, and other things. A Blackberry or Palm costs you $300. But I'm looking for something around $30.

India has the highest sales in cell phones these days. And most of them cost about a thousand rupees, which is about US$25. So you have a pervasive device, and it will get more powerful over the next five to ten years, that's the bet.

When I talk about a PCtvt [see the sidebar for more information], it's a device that has conventional PC functionality but can also act as a TV. The fact that iPod is now providing TV is a good example. It can also be used as an audio conference or videoconference device. So I'm not suggesting anything new.

Everything I've talked about in PCtvt already exists, except not all the functionality is built in the way I want it. If I have a microphone, a camera, and a TV tuner card added to a regular PC, then it becomes a multifunction device. At that point you don't design the system the way you've designed the PCs for programmer use, with file systems and such; trash all of that and make the devices like iPods, appliances. You can listen to music; you can see video; you can do other things. Each functionality should take no more than one minute to learn. Like TV—you click on the TV and click on a channel. If you gave me a simple digital video recorder where I simply select the channel and say record this until I stop it, that's not a very complicated appliance. It's just a question of what you're willing to do—you have to simplify, radically simplify, so that an illiterate person can learn and use it in less than one minute.

BAKER: I'm curious how people will pay for the services. There seem to be two models: pay-per-use or a flat monthly fee. Both have pros and cons. With a flat fee, if you don't use it, you're still paying, which is a problem. On the other hand, you know what to expect. With

pay-per-use, there are sometimes bad surprises. Either way, this seems like a difficult proposal in some economies.

REDDY: I'm proposing a hybrid model. Current models say you're allowed 700 or 1,000 minutes. If you go over, we're going to sock it to you. And so there's this forcing function to sign up for more than you need. But let's say you're not using it at all. You're not costing anything. Rather than force you to pay for 700 minutes, suppose you pay this much every time you use it, but there's a maximum. Maybe $3 a month. That's already a lot of money in a village where they only earn $30 to $50 a month. So you need to have a maximum, and you just use the service. You buy the device, like a car or TV. And then you use it without limit, but we'll guarantee it won't cost you more than $3 a month.

BAKER: So you can avoid disaster.

REDDY: Yeah. However, we want you to use it a lot because the whole idea is that communication is the lifeblood of economic development. So we want people to be able to communicate without worrying about whether they can afford it.

My proposal is that if a government were to pay for the bandwidth and I buy the device, the service provider is just an intermediary. He shouldn't charge anything at all, but because he has to maintain everything and hold my hand, there's a charge. The first 100 calls are only a penny or so each, and there's a $3 maximum, of which 10 percent goes to the government for taxes. But they still make a lot of money, even if there's competition among companies and they have to divide it up; for a billion people, $3 per person is 3 billion dollars a month. Even if there's only a 10 percent tax for providing the infrastructure, $300 million a month is a nontrivial amount for providing and maintaining the infrastructure.

BAKER: What about the model where there's one phone per village or group of people?

REDDY: That's the Grameen phone idea, where in collaboration with a bank the cell phone company provided a phone to an entrepreneur in each village of Bangladesh. It's analogous to a pay phone except that the phone comes to you instead of you going to the phone.

If a person in a village could have their own phone, they would have it. If they could talk without limit to their sister and brother and parents, they would do so. It's just that they can't afford the expense. All of us experienced that 30 or 40 years ago, when I would call India and it was a bad connection half the time and was very expensive. Now the cost has come down to 5 percent of what it used to be, the connections are much better, and I can dial direct.

> **What will the world look like 20 or 30 years from now, when everything is pervasive, there's unlimited bandwidth, devices are affordable by everybody, and learning to use them is simple?**

It's a question of timing. The Grameen phone idea was okay for the time it was invented.

What you and I need to be thinking about is, what will the world look like 20 or 30 years from now, when everything is pervasive, there's unlimited bandwidth, devices are affordable by everybody, and learning to use the device is very simple?

BAKER: Does this mean that the idea of having a kiosk in a village where there's very little money is also an interim idea?

REDDY: Yes. It might be an idea that lasts for 20 or 30 years if people can't afford their own computers. But some people can. Ten to twenty percent of the people even in a village already have TV sets. If you can own a TV set, you can own a computer in the future; it's about the same cost. Then that leaves the remaining 80 percent as have-nots. What happens to them?

We're proposing three different models beyond the private-ownership model. One of them is a shared-community model. In an apartment building, all the people might have a single computer, and then they all sign up for it like we used to for computers 40 years ago, and everybody gets to sign up only for so many hours. In this model we're all sharing the cost of owning a computer.

The second model is that I have to walk from my house to someplace else, which I don't want to do most of the time. And go sit in some strange place and then use the device and pay a fee. We also have privacy and security issues.

BAKER: The Internet café.

REDDY: The Internet café model. But we use it because that's all we have.

The third model is a rental model. Let's say I want to watch a movie. I order my DVD. They not only bring me my DVD, they bring me a laptop on which to play it, and they come back and pick it up in three hours. And so there's a charge; it's another business, just like the cell phone in the Grameen phone business. I think all these models will coexist. But ultimately, as the cost of computation, memory, and so on goes to zero, everybody will have their own. They will say, I have one because I want it and can afford it.

Those are the models that will evolve over time to solve the three problems of infrastructure, access device, and the ease of use even for people who aren't literate.

BAKER: How about content? Doesn't it cost money and take resources to create and maintain content? Where will it come from? How will it be made appropriate for the community? Is there a role for open source and open content here?

REDDY: Open source and content are clearly an important way of causing things to happen, especially in the emerging economies. More important than open source is what has happened with content, like Wikipedia. The emer-

gence of Wikipedia, its stability and accessibility, is truly amazing. For a long time people thought that a special content preserve, which was AOL or MSN or something, was the only way you could get the content. And then out of the blue came the Internet and the WWW. You just published; you didn't need to be on AOL.

The same thing has happened with Wikipedia. It's public content versus Encarta or Britannica and such. And that's a very interesting development. What that says is there are lots of things that want to be free.

On the other hand, there are also lots of things for which you have to pay some fee for service. We need to understand both models and how they coexist, rather than say everything has to be free or everything has to be for a fee.

The content part is very interesting because that's where people will make the most money—not on the infrastructure, not on the device, not on the system software. So the content is going to be king. Anybody with any kind of creativity can produce content and put it out, and then it's purely a question of how they discover you. Maybe you pay for the content indirectly through advertisements, maybe you pay for a subscription, or maybe you pay for use, but with a cap to your maximum payment as we discussed before.

The best current example I can give you is the one that Amazon is using. Amazon is working with the publishers and saying, you want to buy this book? It's $10. If you only want one page, we'll give it to you for 50 cents. But after you've bought 20 pages, you might as well buy the whole book; we'll give you the rest for free. I think that's a good and clever model.

BAKER: You've described how we should simplify these devices so that literacy isn't required. How far can we take that? Where is literacy required?

REDDY: The answer is what Mike Dertouzous of MIT used to call "gentle-slope systems." The term "gentle slope" means easy things should be easy to do.

If I need to do something harder, maybe I need to learn some more.

My suspicion is ultimately we'll have a situation where more than 50 percent of the people won't be literate in the classical sense of the word but still can enjoy the benefits of information technology. And if a guy can't become literate, you bring him the system a different way. Because one way or another, we want to get these information technology appliances into people's houses. Once they're there, since they're actually part of a general-purpose computing device whose capabilities you haven't disabled, the children and grandchildren of the family will have the opportunity to explore further, to learn more, and pretty soon we'll have a literate population.

For access to entertainment and communication, they might not have to be literate. For other tasks, they might need basic literacy. One project we're doing as part of all this is to set up a driver-training school to create jobs. In a driver-training school, the students have to learn to read and write (they spend a quarter of the six months learning how to read and write—read, at least) because they have to read road signs.

There are opportunities for demonstrating by need why people should know how to read and write. And that will happen over time. When your tummy is full, it's easier to say you have to learn to read than if you're hungry and are wondering where your next meal is going to come from.

GENEVIEVE BELL: AVOIDING PITFALLS WHEN DEVELOPING TECHNOLOGY FOR EMERGING ECONOMIES

BAKER: Could you give an introduction to your field for the layperson—what it's called and what you do?

BELL: I'm a cultural anthropologist by training. I did my graduate work at Stanford. I'm now a member of a growing number of research social scientists working and located outside the academy but still doing anthropological work. My subspecialty is ethnography,

which is a holistic way of attempting to understand the world from a cultural perspective. It's both a methodology and a theory, by which I mean ethnography implies a particular way of making sense of the world that is informed by distinctive methods and critical theory. It's about going to the places where people are living their lives, spending time with them, making sense of the everyday through local eyes. We call this *participant observation*.

Participant observation is the idea that you learn not only by watching what people are doing but also by doing it with them. I think one of the challenges for many of us when we spend time in cultures that aren't our own is how we make sense of what we're seeing. There's a great temptation to see one action and then another action and then to draw a connection between the two. And when we do that, the meaning we attach to it is the meaning that we bring from our own cultural perspective.

As an anthropologist, I try to hold off attributing meaning to those acts and the things that connect as long as I can. I am always trying to work out what the people in the place I am studying would imagine to be the connections between those two points or the thing that makes everything make sense. So what I am trying to do is get the local meaning, the local perspective—ultimately, the local culture. For many of us, the best way of doing that is still actively being there and engaging with people—not just watching. When you watch, it's easier to let your own perspective and cultural heritage come to the fore. When you're actively engaging with people, it's harder to do that. You have to be much more into their kind of moment and their mindset.

Ethnography then is participant observation and the theories behind it; this notion of decentering yourself and familiarizing yourself with what's otherwise an unfamiliar set of activities. Ethnography is also about the telling of stories, about communicating insights, about making sense of the material that

you've gathered in the field through a series of positions and techniques. Some of it's about thinking holistically—not thinking about people just in the instance of the use of a particular object, but the way that object fits into a larger cultural framework. It's partly about the rigorous theories that we bring to interpret the data we see: theories about material culture, about human relationships, about ideas of identity, race, gender, nationality, sexuality. Ethnography isn't just about writing down what people tell you. It's not just an act of transcription. It's also an act of translation, of making sense, of interpretation.

BAKER: One thing I noticed about your MobiSys 2004 keynote address was that you were right there in the middle of things, living with the people whose use of technology you were studying.

BELL: Absolutely. If you want to develop new technologies or innovate old technologies for different contexts, you're crazy if you don't go to those contexts. If you want to build something for Mexico, go to Mexico. If you want to think about what a piece of technology looks like in Nairobi or Cairo or rural South Australia, you have to go those places because your own imaginings of them are often profoundly flawed. But it's not just a matter of going there and looking. You actually have to interact with people and talk to people. For me, one of the reasons you also want to do the participation piece is that sometimes when you go and look, you're sometimes looking for the wrong things. You're asking misplaced or misguided questions, questions that don't lead you to helpful answers.

One of the things that you're seeking to do is work out what the right questions to ask are. What kinds of questions will get you to what is most useful and most interesting?

BAKER: But a lot of us have no training in doing this.

BELL: Indeed. One of our responsibilities as researchers, as scientists, as

technologists is to develop interdisciplinary organizations to do this kind of work. You would no more expect me as an anthropologist to design a better piece of silicon than I would expect you as a technologist to be able to understand someone's eight-subsection kinship system. So if you want to develop genuinely meaningful technology for these places, you have to rethink the kind of teams we put together to do that sort of work. You need a research social scientist on your team. Sometimes it isn't just a technical solution. It's a cultural one.

We need to be really mindful, as we develop technology for these emerging economies, that we're not seduced by

> **One of the things we need to be really mindful of as we develop technology for these emerging economies is that we're not seduced by the "emergingness" of the economies.**

the "emergingness" of the economies. We often imagine that they're on a trajectory to end up just like the US or Europe and that this means they're currently somehow an underevolved version of the US or Europe, but it is more complicated than that. There are lots of different trajectories along which countries develop and technologies are adopted and innovated. In emerging economies, conditions are very different, and the infrastructural availability is very different, but it is not always worse. Some of the early trials of things such as Wi-Fi and WiMax are happening in places like India, where the leapfrogging of previous infrastructures means that in some ways consumers there will be ahead of the US. China is always going to be well ahead of the US in terms of the number of cell phone consumers and sophistication of the technology

platform. I think what you will find when you spend time in these places is an abundance of different kinds of infrastructure and creative solutions to problems: running PCs off truck batteries, hand cranks for cell phones, public power infrastructures such as the ones in China. People are working out all kinds of ways to solve some of these problems, such as handmade dust covers and tea cozies for computers to keep out bugs. People are developing novel local solutions.

That's part of the reason having a research social scientist as part of your project team makes a big difference, because one of the things we bring to the table is saying that you have to understand that these are coherent cultural blocks of their own. They have long and distinguished histories. Some of these places have had an idea of themselves for thousands of years. These aren't cultures that are emerging, sometimes not even economies that are emerging now. They were predominant a century or two centuries ago. What we have to think about is that these aren't places that are going to look just like America. Chances are they're going to develop along very specific local cultural trajectories, and paying attention to those things is important. Thinking about how those things shape people's relationship to technology becomes an incredibly powerful way of thinking about how you develop technology that's locally appropriate.

BAKER: Is there a particular example of a technology where the creators' assumptions were severely misguided?

BELL: How about assuming that the whole world is on 110 volts, like America is on.

BAKER: People have actually made that mistake?

BELL: Oh, yes.

Some things require a different imagining line. For me, there's no moment more provocative than being in the field in Malaysia and having someone say to me, "I used my cell phone to find Mecca," and realizing that here was a

question I would never have known to ask. When most people in the US or Europe think about cell phones, the first thing that springs to mind isn't what religious place or practice your cell phone supports. If you hadn't been there watching people do that and having people talk about it, you wouldn't have known to ask about it. That was pivotal in my own thinking about what people were doing with technology and the fact that these technologies were fanning out around very specific trajectories, many of which didn't resemble the one in the States or Europe.

BAKER: Or each other, I would assume.

BELL: Indeed. The other thing that's deceptive when we talk about emerging economies is thinking they're all the same. Let's think about who gets put in that category: China, India, Brazil, Mexico, Russia, Indonesia, Nigeria, Turkey, Egypt. These are places that have very little in common with one another culturally and often have very little to do with one another in terms of why their economies are considered emerging, and the histories of those economies are very different.

What do they have in common? A lower per capita household income. That's not a really good defining feature. There are also a few things that many of those places share around infrastructure. Electricity isn't everywhere and abundant and cheap. High-speed data connections aren't everywhere, abundant and cheap. Temperature has extraordinary variation, and houses aren't climate controlled. People's domestic and work physical spaces are often much smaller, contain many more people, and are built out of materials that degrade in ways that are bad for technology. There's all the dust. Many of these places have in common strong ideas of social collectives; so, it's not individuals owning things, it's often groups of people sharing things.

BAKER: Like family collections of mobile phones in baskets at the front door.

BELL: Exactly, or public cell phone

charging stations or multiple people sharing a PC, or the classic example in Bangladesh of a whole village sharing a cell phone. I think many of those things are true across many emerging economies. Much of that whole description might characterize rural India, but it also works in rural South Australia.

When you think about the emerging economy, you have to understand there are different possible goals. Do we mean to develop technologies that have a lower price threshold—that is, can be more easily afforded in places where people have a lower GDP? Or do we mean technologies that are designed to inhabit spaces that look very different from the ones in the West either because

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of infrastructure, activity, or size? Or do we mean to support very different cultural experiences and relationships? Any one of those things can point you in a very different direction.

BAKER: Okay, you just mentioned several things, all of which are challenges when you're thinking about a technology for a particular area. The first of them is lower price.

BELL: Yep. So do we just need to develop things that are cheaper?

BAKER: Or is the technology for different spaces, infrastructures, or environmental challenges?

BELL: Right, do we need a hand crank for batteries?

BAKER: Or to support the different ways that people interact.

BELL: Yeah, so is it collectively owned? Is it like the Community PC that Intel is currently offering in India or the Gra-

meen Bank mobile phone where they've given one cell phone to a village?

It's not just about economics but also other kinds of practices and cultural experiences and desires and aspirations we're supporting. There are some disconnects that arise. One thing that really characterizes American culture, for instance, is a focus on a construction of the individual. We like to own things individually. I think it's very hard for many of us to think about places in the world where that isn't the case. This has a profound impact on the way we design technology. What would it take to make a computational device explicitly designed for being shared, that would never be owned by a single person, that would support multiple people's tasks concurrently?

Another area is privacy. One of the things that for me is fascinating in India as well as some other places in the world is that some of the emerging cyber café landscapes are mostly supported by the government. You have these really interesting situations where the owner of those kiosks is often literate—that is, someone who isn't only computationally literate but also reads and writes government forms. What you end up with is interesting interaction paradigms where you have this person who isn't unlike what the European scribe would have been. You're communicating what we would think of as quite personal information if you're having someone else fill in your tax form or the certification form for the marriage of your daughter or if you're communicating with relatives somewhere else about money or family matters. A whole lot of information that we would imagine as something you wouldn't share is now being shared with a third party. We concentrate often on the devices and the applications, and there's a larger set of questions we could be asking that become really interesting in this space. As we design these services and applications and objects, are we making assumptions about ideas of security, ideas about privacy, ideas about trust, location, identity, risk?

It's also the case that there's probably in the United States a microcosm of different ideas about privacy, security, trust, and risk. In asking about emerging economies and what's an appropriate solution, we sometimes forget in the US that we have our own internal emerging economies.

BAKER: In putting together design teams, where do we find ethnographers who can do this analysis and participation and understanding of the local context?

BELL: There are anthropology departments in almost every American university who produce researchers, and the same is true in many other countries.

BAKER: Do the anthropologists fresh out of grad school have the background and training to jump right into this?

BELL: The training I most needed—that is, a capacity to think critically, to have been trained theoretically, to have done prior field work—are all things they've done. Not all of it was focused around technology, but it doesn't need to be. If you imagine that technology is just another material artifact, then whatever they've done their field work on has been around one of those objects or around people's relationships to one another through objects. So the fact that it's now a cell phone rather than the circulation of shells should make almost no difference. The challenge is more that for many academically trained anthropologists, the desire to work in industry is low. That's still seen as being a problematic endpoint.

But boy, has this been fun! We've actually been thinking about how you build out this kind of user-centric, people-centric experience focus as a core competency. It's a core competency like software, like hardware, like architecture, like strategic planning. I sit on the staff of Intel's Digital Home Group. I wanted insight into what's going on in the platform groups so that I can follow things through the platform. This is a strategic role rather than a service role. We're not there providing databases of cultural practices. We're there driving the process.

Part of it is taking the engineers into the field so that they see it the way you see it. Part of it is working with engineers, product managers, and software and hardware people to make sure that there hasn't been a misunderstanding. When you've said "quiet," what they've understood is that it should be "x" volume, and in fact you mean it should be -10x because quiet in Korea means something very different than it does in Indonesia, for instance. How do you make sure that what we have historically imagined to be technical specs are in fact also cultural ones?

Much technology has been designed with a very particular set of Western parameters in mind. Other people have

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hacked them to make them work elsewhere. Let's imagine that in reverse. Why would we not imagine that technology designed elsewhere might come back to the West? Lots of other things move that way: fashion, music, consumer goods, color. What hacks would we users in the US or Europe have to make so that others' technology functions for us? Why would we imagine that a $100 PC would be only for an emerging economy?

Having to design technologies for more-challenging environments requires us to reexamine many questions, and this is going to be good for everyone. Thinking about alternate power sources, for instance, is something that isn't just going to have a ready audience in an emerging market. Increasingly in mature markets too, there's a focus on energy efficiency and energy conservation. Thinking about

things that are robust and rugged isn't just going to appeal in rural villages in India or Indonesia. It would make just as much sense for people outdoors in the US.

BAKER: It's the technological bleeding edge, but not in the way that people are used to thinking of it in the West.

BELL: Right, and if you solve it first, you've probably solved everything in between.

BAKER: Are there different cultural expectations around who should know about technology?

BELL: Oh, yes. One of the things that I was most struck by when I was doing fieldwork in Singapore was that the latest attribute one wanted from one's nannies and maids was a capacity to troubleshoot computer networks. Along with a capacity to cook and clean and do child rearing, there was a network maintenance requirement.

BAKER: Is there anything you'd like to add that I've neglected to ask you?

BELL: One of the things I was starting to ask last year was, were there other ways to aggregate populations across the globe that got you to sizeable markets but that didn't necessarily have a country focus? Are there other ways that people imagine solidarities with one another?

BAKER: Religious links?

BELL: Exactly. 800 million Catholics. 1.7 billion Muslims. Across a lot of different countries. Are there religious ties that trump nationality, at least when it comes to purchasing a particular set of objects?

I've also yet to see a piece of technology that was truly explicitly designed for women, another great emerging economy.

In emerging economies, it warrants paying attention to social relationships more than we normally do. That means thinking about gender and power and age and not being swayed by the notion that a piece of technology in the home means that everyone uses it equally. These are our chances to avoid repeating some of the mistakes that were made in mature markets. ▣