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ack in 1997, Katina would use International Telecommunications Union (ITU) estimates of incoming and outgoing voice and data teletraffic tables for her work in strategic network engineering. She was particularly amazed when viewing these figures in global thematic maps, as thick arrows would always flow in and out from developed nations, and yet significantly thinner arrows would be flowing from developing nations, despite the difference in population counts (1). That image has stuck with her as a depiction of how the world is, no doubt, related to historical events. Efforts required to bring those arrows into equilibrium at a country level seem somewhat impossible, given the digital divide.

As initiatives like Project Loon attempt to grant all peoples Internet access (2), there are still many places on Earth that have limited or no connectivity whatsoever. Some of these places reject services, believing that they will bring with them even greater harm, such as deforestation or a destabilization of culture and religious practice. And yet, developed nations uphold that they are in fact educating, providing, and

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allowing for longer-term economic and social sustainability through their technological solutions. For example, Jason has recently returned from the eastern part of the Maharashtra state of India where the use of technology in remote villages such as Jamnya appears at first glance to be at direct odds to the subsistence way of traditional village life. However, on second glance, the benefits of technology offer endless possibilities from education to weather station assistance with crop plantings. See also, Khanjan's projects in Africa (3).

But what about long-term stability in developing nations? For example, as we strive to mainstream alternate energy sources and make them accessible in resource poor communities (4), how do we think beyond the technological and economic dimensions and ensure respect for social, political, and environmental imperatives?

Computers, including the tiny but powerful ones on cell phones can be game-changers, but they will not save lives directly. They cannot be eaten by a starving population. And then, they need to be serviced and maintained. Jason, along with Katina's husband Michael, visited and taught Karen refugee students in camps and remote villages on the Thai-Burma border (5). They quickly realized that computers work only if they are connected to electricity. Someone has to pay the bill. Computers can thereafter continue to work, if no parts go missing, and they are fully enclosed within a shelter that has windows, and are not damaged. Computers can be operated by people who have received some training and where there is some connectivity. It is hopeless to want to share files or use remote applications if bandwidth is lower than 56 kbps. For example, Martin Murillo *et al.*'s article in this special

section emphasizes that leading humanitarians have identified data communications for remote health offices as one of the top three tools that will contribute to the fulfilment of the Millennium Development Goals (MDGs).

Today, as many as 80% of the world's citizens reside in areas with mobile phone coverage (6). Increasing access to computers and cellular devices has allowed telemedicine systems to flourish in developing countries. But these devices can only really work if technologies are integrated into local communities in bottom-up socialization practices. They can work if they are embraced by locals, and harnessed for good by local companies, NGOs, elders, and other stakeholders. While the number of mHealth and telemedicine systems is growing, the benefits of these technologies are yet to be fully realized. Many mHealth ventures in resource-constrained environments suffer from "pilotitis" – an inability to expand beyond the initial pilot and ultimately become sustainable ventures. Khanjan has led the design and execution of a cash-positive telemedicine venture in central Kenya that now has seven full-time employees. His students recently conducted a study of the failure modes that plague the growth of mHealth pilots in the developing world. This study of over 50 projects in Africa and Asia uncovered a wide range of barriers including financial challenges, business structures, technological limitations, and cultural misalignments. Once again, some of the greatest challenges were related to bottom-up socialization, melding Western and indigenous knowledge, and integration of new technologies,

approaches, and business models into traditional ways of life. Khanjan has captured the nuts and bolts of "how things work" and why projects fail in a series of short stories called *The Kochia Chronicles: Systemic Challenges and the Foundations of Social Innovation*. These narratives take readers headlong into the lives of people in a quintessential African village as they usher in an era of design, innovation, and entrepreneurship.

It is difficult not to be cynical about initiatives such as Zuckerberg's hopes to wire the world (7). These technological initiatives sound good, but with computing also will come social implications. Not all of these implications will be positive.

But back now to getting those inflows and outflows to look more alike, as newly industrialized countries have experienced growth since the inception of the mobile phone (e.g., India), broadband (e.g., Singapore), and manufacturing machinery (e.g., Thailand). The bottom line is that to overcome the endemic failures that inhibit the sustainability and scalability of well-meaning projects, a truly systemic and participatory approach is essential. Rather than dwelling on the problems caused by, or that might result from, the digital divide, let us preoccupy ourselves with considering digital inclusion as a primary aim. Digital inclusion is not just about offering equity but about making substantial self-determined improvements to the lives and livelihoods of people in resource-poor settings. The digital divide will never be entirely bridged, but inclusion can be propelled through social innovation, concerted time, and effort supported by multi-lateral funding from local and global

stakeholders who not only understand the need for change but are passionate about the human need and its interdependence with global peace and sustainability.

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