
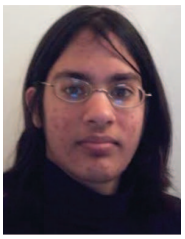


SAMIR PATEL | SIRI MALEY | KHANJAN MEHTA

Appropriate Technologies in the Globalized World: FAQs

Technological innovation over the past century has revolutionized our society's ability to solve problems. A byproduct of this movement is the advent of appropriate technology, an approach to address challenges in the developing world through creative and people-focused product development. Appropriate technology (AT) recognizes that social, environmental, cultural, political, and economic concerns are just as important as technical requirements in the design of innovative products and services [1]. For example, Husk Power Systems converts rice husks into electric power in rural areas of India's poorest, most remote state [2]. The success of Husk Power is as much in their technological solution, as their consideration of socio-cultural realities in the design of their revenue model. Treadle pumps, like those produced by KickStart, help farmers increase their cultivable land, extend their growing seasons, improve their crop quality, and thus, augment their income [3]. The driving force behind these technologies is a desire to employ human-centered approaches to empower communities in addressing their own economic, sociocultural, political, and environmental needs. Such technologies can improve the lives and livelihoods of individuals living in resource-constrained environments in many ways, from improved access to food, water, and healthcare to long-lasting shelter and employment opportunities [4].

There are many competing theories about what constitutes "appropriate" technology and how to define and balance "people-centered" goals against other dimensions of sustainability. The challenge of defining "appropriate" technology has been discussed at length in AT literature for decades. Despite some differences, this discussion has come to some agreement on a core group of design tenets that span from the cultural (e.g., compliance with societal norms), to the consumer (e.g., community ownership model), to the technological (e.g., environmental friendliness). However, the relevance and intended implications of the tenets have evolved with the gradual globalization of challenges, resources, and economic systems. One of the most significant outcomes of globalization has been the rapid proliferation of Information and Communication Technologies (ICTs), which have democratized the creation, access, and utilization of knowledge. This knowledge, especially when melded with indigenous knowledge, enables individuals and communities to

Digital Object Identifier 10.1109/MTS.2014.2301855
Date of publication: 10 March 2014

pursue appropriate technology in more ways, co-creating solutions that can improve their collective quality of life. This article suggests that instead of considering AT design tenets as rules for technology development, they must be considered as a series of tradeoffs and systemic design decisions that are informed and co-created by the specific communities and their context. Along with relevant real-world examples, this article presents a series of thought-provoking questions that must be answered when engaging in the design of technology solutions for resource-constrained environments.

Over the last decade, the Humanitarian Engineering and Social Entrepreneurship (HESE) Program at Penn State has led technology-based social ventures in Kenya, Tanzania, Rwanda, India, Cameroon, and other countries. Through approximately thirty different projects, we have found that AT solutions are too nuanced to be generalized across contexts, cultures, and specific desired outcomes. Though all aspiring AT projects have the same overall goal of improving the lives of resource-constrained communities, they operate in different environments to address dissimilar problems. For instance, a company attempting to provide electricity to rural Indian villages need not adhere to the same tenets as a group helping a community reconstruct a water reservoir in Kenya, or a venture commercializing affordable food dryers in Nicaragua. We argue against the application of rigid tenets and design principles and encourage innovators to adopt a systems approach when developing new technologies. We ask the entire community engaged in appropriate technology — innovators, educators, students, entrepreneurs — to consider how we all should really be designing such technologies. To what end, and by what means, should this movement progress?

Aid distribution is often more about the politics of the deliverers than the economic and social needs of the recipients.

Questions on Appropriate Technology

Should we Design Technologies for Aid or for Trade?

There is considerable discourse in the development community over the usefulness of foreign aid. Over the past 50 years, more than two trillion dollars in foreign relief have been transferred to Africa. Paradoxically, Africa has a lower real per capita income today than it did before this aid began [5]. The "Marshall Plan for Africa" has not worked, but why? And what does this tell us about the appropriate circumstances for foreign aid? Despite best efforts, aid distribution within the current infrastructure of developing nations is often more about the politics of the deliverers than the economic and social needs of the recipients [6]. Arguably, such aid-based models of development lead to inefficiencies and waste in the entire system. For instance, foreign aid agencies donate millions of dollars to developing countries to combat malaria by distributing free insecticide-treated mosquito nets, but these programs have efficiencies comparable to programs that espouse cost-sharing with customers [7].

Should we be donating products when cost-sharing with recipients is just as effective and has the added advantage of fostering a sense of ownership? What else can we do to lower wastage? One way of combating foreign aid waste is to invest the funds in local programs that catalyze more opportunities for employment and self-empowerment. For instance, foreign donations could enable micro-lending for small businesses or financing for public goods like infrastructure development projects. Instead of donating mosquito nets, foreign aid might invest in social ventures like NetMark, a company that builds facilities and trains local residents to manufacture low-cost mosquito nets for the local market [8]. The "aid versus trade" question is important because of the customer-consumer relationship. When foreign entities donate to non-profits or developing-nation governments, they separate the customers (NGOs and governments) from the consumers (people: end beneficiaries). When customers don't understand, or don't articulate, the needs of the population correctly, the resulting solutions are likely to fail. This phenomenon is less likely in market-based ventures like NetMark, where the customer and consumer are one and the same and the feedback systems are fast and effective.

Alongside the aid vs. trade debate, we must remember that a major application of foreign aid is in short-term humanitarian relief. For instance, disaster relief funding can be necessary for countries and communities to address immediate, short-term challenges and avoid further danger [9]. In the wake of catastrophic natural disasters, devastated communities cannot rely solely on market-based or locally-developed improvements. However, the consequences of tragedies (and potentially the causes, in anthropogenic cases) can be mitigated by building resilient systems through effective long-term planning. Disaster aid is certainly necessary in some instances, but it should not last so long that it weakens the society's economy and perpetuates its dependence on foreign donors.

Should Technology Solutions Leverage Western or Indigenous Knowledge?

Technology carries with it certain knowledge, perspectives, and lifestyle concepts. Traditionally, AT

theorists differentiated these concepts into "indigenous" (local traditions and understandings often passed down through generations) and "Western" (positivist and scientifically-derived information, often from the developed world). Often, external technologies will challenge local traditions and champion a Western perspective. New ideas can help catalyze change and generate appropriate solutions that meld Western and indigenous knowledge. However, excessive deviations from indigenous perspectives often lead to the failure of AT projects. In principle, ATs should leverage both Western and indigenous knowledge – but how can they be balanced?

> Should we be donating products when cost-sharing with recipients is just as effective and has the added advantage of fostering a sense of ownership?

One example of such a balance is KickStart's manual treadle pump, which allows communities to access clean water quickly and easily. The initial design of the treadle pump caused women to move their hips in a provocative manner, leading many communities to reject it. Subsequently, indigenous perspectives and knowledge informed the redesign the pump's pedal geometry in order to satisfy the communities' cultural norms and expectations [3]. Sustainable Health Enterprises (SHE) in Uganda took on the problem of young women missing school due to lack of sanitary pads during menstruation. SHE adopted a more Western perspective, advocating against this status quo by making sanitary pads affordable and accessible to schoolgirls. They leveraged indigenous knowledge to make pads from eco-friendly natural materials like banana bark and employed traditional cooperative business structures to integrate this product into the local marketplace. They successfully improved the girls' school attendance while augmenting livelihoods and stimulating the local economy [10].

Is a Technology Appropriate if It Violates Cultural Norms?

New technologies often clash with local cultures. This could be unavoidable, as with ubiquitous technologies such as the Internet, or unintentional, like the treadle pumps that did not consider local cultural sensitivities. Even when ventures try to mitigate both these possibilities, achieving harmony with local cultures can be difficult [11]. For example, cell phones inherently compromise cultural traditions and face-to-face conversations in rural areas. On one hand, we can blame cellphones for the destruction of traditional culture. At the same time, cellphones have enhanced the lives and livelihoods of billions of people, who have readily accepted the technology and adapted their cultures accordingly. Culture is dynamic and should not be museumified either.

Instead of outsiders dictating a specific definition of cultural preservation, local residents should be empowered to choose the life they want. On one hand, the evolution of culture may be secondary to basic survival and an improved quality of life. Conversely, technology should not force a community to lose an identity it wishes to preserve. When foreign breakfast cereals were introduced in Kenya, their popularity among expatriates threatened the traditional Kenyan breakfast industry. This was true even though the foreign cereals had a higher cost per nutrient ratio than that of the traditional diet. The loss of traditional food habits did not improve community nutrition but instead worsened it [12]. Culture is a dynamic entity and technology-driven social development is a valid basis for cultural evolution. Outside innovators can introduce game-changers and culture-changers, as long as the users maintain their right to determine which technologies and cultural artifacts they want to adopt and which ones they want to discard [13].

Should AT Products be Localized for a Specific Region or Standardized for a Larger Population?

One of the most crucial design decisions for an AT venture is whether to standardize or localize a particular product. Standardization means delivering the same product across cultural and geographical markets, while localization treats each community as a "cultural being" and designs for specific needs and behaviors [14]. Standardization engenders reliability, quality control, and cost-effectiveness, and thus enables greater customer access. Localization ensures that the needs and preferences of specific communities (market segments) are met. However, it also implies dozens of variations, higher upfront design costs, and higher price points that could ultimately render the product unaffordable.

At the height of the appropriate technology movement in the 1980s, ATI developed a sunflower oil press designed specifically for small communities. The press was efficient and fit perfectly in the community. However, at a cost of nearly $200, it was too expensive for the target users. Nearly a decade later, KickStart developed a cooking oil press that costs less than $30 and has helped over a million people [15]. Their success can be attributed to standardizing and producing one specific product instead of several locally-attuned versions. Even if a venture accepts the benefits of standardization at the manufacturing level, implementation may not be possible without localization. For example, while the design of a basic mudbrick press might be

standardized, the entire mudbrick building system must adapt to dissimilar climates and soils in different parts of the world. Localization in high rainfall areas might involve stabilizing the bricks with a mud-cement mixture, despite the additional cost in terms of press maintenance and design. In this case, the product (press) might be standardized while the educational regimen is customized to the specific context. Clearly, there are many shades of grey within the standardization versus localization decision for technology ventures, but an ideal medium is often possible.

Should Technologies Rely on Local Materials and Manufacturing Operations?

Local production comes with many social, economic, and environmental trade-offs for appropriate technology ventures. How important are profit, people, and planet to each AT venture? Profitable ventures are more likely to scale and deliver their technologies to more people. However, if such a venture employs destructive manufacturing practices, is the benefit of reaching more people worth the collateral cost? Local manufacturing for local markets with locally-available raw materials can lead to resilient businesses that can quickly respond to the evolving needs of communities. At the same time, other social ventures insist that using local manufacturing and resources compromises their business models and cost effectiveness. For example, KickStart treadle pumps and irrigation systems are manufactured in China due to cost restrictions [16]. Similarly, biomedical ventures like ClickMedix face cost and quality control barriers when trying to manufacture locally [17]. Despite the additional transportation and logistics fees, outsourcing is sometimes necessary to maintain economic sustainability. In situations like these, the venture must accept that all development goals cannot be achieved simultaneously. Foreign manufacturing usually means fewer jobs and relatively less economic empowerment for local residents. It may also lead to negative environmental outcomes due to industrial manufacturing and international shipping. On the other hand, developers may be able to make foreign production "greener" than local alternatives, for instance, by utilizing more expansive material options, recycling facilities, and energy infrastructure.

> Often, external technologies will challenge local traditions and champion a Western perspective.

What happens when imported products malfunction? Are tools, replacement parts, and skills available to easily repair the product? Lack of technicians to maintain and repair expensive biomedical equipment aggravates healthcare challenges in Africa [18]. On the other hand, although cellphones are not designed or manufactured on the African continent, ecosystems have emerged to support them and accelerate their adoption. Thousands of cellphone repair technicians, most with little formal education, eke out a living repairing commonly-used cellphones. The key question is whether the technology is sustainable in the long term despite being manufactured elsewhere.

Should Technologies be Designed for Individual or Community Ownership?

Though the local community can implement, and benefit from, water reservoirs, schools, bridges and similar infrastructure projects, community ownership of certain technologies is not practical. For example, large greenhouses can be used and shared by communities by allowing individuals some level of access. This allows users to pool resources and afford expensive technologies while enhancing the value derived from them. However, the exact nature of that shared ownership can be difficult to negotiate and control. How is space within the greenhouse allocated? Who can receive the crops grown within it? How will maintenance and repair requirements be handled? How are theft and destruction prevented? Who ensures that rules are followed? To achieve equitable group ownership, the community must build on trusted relationships to clearly define and regulate the operational model that serves the needs of the diverse stakeholders.

This need for trust is evident in the business model of Husk Power Systems (HPS), a rural electrification company in India. The company uses renewable energy sources to produce and supply electricity on a per diem basis at a low cost. User accountability is sourced through community monitoring: people's homes are open and everyone can see what appliances are being run. Neighbors are billed together, so everyone watches one another to ensure they are each paying for what they use [2].

In short, there are many issues to consider when deciding what level of community involvement a venture should pursue. More expensive technologies may require the pooled resources of multiple households. Highly location-dependent ventures, such as infrastructure projects and healthcare services, might benefit from a participatory approach that directly involves the community in venture development. Tight-knit, open-home communities accustomed to central management or cooperatives will likely be a better fit for community ownership than a more individualist culture with single-family homes and self-contained technologies. At the same time, some of the most successful technologies like cellphones, solar lanterns, and radios are designed for individual or family use.

Must ATs Always Strive for the Cheapest Solution?

Though AT often tries to maximize cost efficiency, the least expensive solution cannot always be assumed to be the most desirable in resource-constrained environments. AT theory must accept that additional expenses may be required to meet the emotional and societal needs of the end-users. Basic designs for greenhouses in developing countries are often based exclusively on efficient function; however, consumer buying is not always predicated this way. We have initiated greenhouse ventures in Kenya and Cameroon that manufacture and install affordable greenhouses for local smallholders and agro-businesses. While developing low-cost substitutes for greenhouse glazing (plastic covering), we discovered that several farmers preferred taking larger loans to buy glazing that looked "pretty" rather than equally-functional but not as good-looking glazing made from used rice bags. Though not based on function or direct economic returns, this superficial distinction is important to the customers and must be respected by technology developers. Similar circumstances arise when customers prefer expensive "brand-name" products that do not differ in quality from generic versions—a phenomenon found among all socioeconomic classes [19]. Poor people expect good-quality products and are often willing to pay more for aspirational products that boost their social status.

> Technology should not force a community to lose an identity it wishes to preserve.

Is a Technology Appropriate if it Benefits Some People but Hurts Others?

Technology solutions may inadvertently, or deliberately, help some entities while hurting others. Is a technology inappropriate if the livelihoods of certain groups are compromised? For example, a venture that provides people with safe drinking water at low costs can benefit many people. However, it might reduce the profits of bottled water and soda companies, or compromise the livelihoods of water vendors or racketeers. Similar challenges arise in food value chains and supply chains for all kinds of products. Customers may prefer to purchase a solar oven and make their own food instead of frequenting a street vendor. Information and Communication Technologies (ICTs), especially cellphones, can make supply chains more equitable and efficient, but do so by eliminating middlemen.

Ultimately, technologies will affect different people in different ways, and some may view the consequences as negative. However, developers must avoid engaging in cultural imperialism and applying their own definition of negative (or positive) impact to the situation. A technology solution is merely a tool: the customers and communities should be able to decide whether they want to adopt the technology or not. Societies can address the needs of those who are negatively impacted in many ways – by teaching them how to leverage the same technology, through re-education or re-skilling programs, or by innovating to find new opportunities for value creation. A technology that negatively affects a certain subset of the population could actually serve as an impetus to increase human capital and systemic efficiency by encouraging the displaced workers to thrive in another field.

Should Labor-Intensive Tasks be Replaced with Automated Systems?

Technological advancements in manufacturing and automation have historically led to periods of lower employment, as evidenced by the Western industrial revolution [20]. When implementing technology solutions, developers must consider any effects their ventures may have on the workforce. Some technologies increase workers' efficiency and productivity, while others might eliminate job functions and displace workers. Are labor-saving technologies appropriate for populations already riddled with unemployment and underemployment?

Mass automation is a clearly logical choice in some situations. For instance, when communities suffer from inadequate food supply, mass automation of food may be essential to its very survival. Such is the case with injera, the traditional bread of Ethiopia, whose traditional recipe is energy and labor-intensive. Fuel costs have increased with desertification, directly leading to the high cost of injera in rural areas. At the same time, the rapidly increasing urban populations living in small quarters do not have the necessary space to make injera. Due to these and other reasons, the consumption of wheat (bread) and rice has increased in rural and urban populations alike. In this case, mass-manufacturing injera in factories is much more efficient and provides the people a way to preserve the most important part of their diet and culture. Although certain technologies can reduce employment and hurt livelihoods, their integration into modern economies is potentially desirable and often inevitable.

Should Technologies be Deskilled to Allow More People to use Them?

A primary characteristic of modern technology is attempting to deskill operation: allow anyone to operate devices with little outside instruction. Deskilling increases the potential customer base of the product

while decreasing complications that arise due to misuse. At the same time, it can foster dependency and not actually address all the systemic issues faced by users. For example, in India, cellphone companies are devoting significant resources to services like mobile money transfers that allow rural populations to easily transfer money for goods and services. However, many less-educated users lack the trust and self-confidence to use the service by themselves. Instead, they go to a local agent for the transaction. In this case, the extra effort to simplify the application for end-users is not needed.

In healthcare, direct-to-consumer technologies have tried to deskill and promote self-medication. Biomedical devices like glucose monitors, scales, and thermometers are marketed to individual consumers. However, the usefulness of certain tests and the implications of their results are often difficult to convey to less-educated users. An example of this would be over-the-counter HIV tests that can be completed in the privacy of one's home. The device is a technological improvement, but the educational and medical information needed after an HIV diagnosis, whether positive or negative, is not readily accessible to individuals. Therefore, many patients still go to testing centers for assistance. A more appropriate approach to this system might involve increasing Community Health Workers' access to these devices and the necessary post-diagnosis educational material. This paradigm would refocus efforts away from deskilling, more towards the entire pre- and post-diagnosis user experience. Technology developers must look beyond developing the specific technology to incorporate systems-level issues into the design process. They need to consider who will be using the device, what their educational level will be, and what situations the technology could precipitate.

> High-tech solutions can lead to simple low-tech products that are more likely to be sustainable in low-resource contexts.

Should Low Technology Products be Emphasized over High Technology Products?

"Low technology" involves skills predating the industrial revolution, which are often the only options readily available and sustainable within the existing infrastructure of developing communities. In contrast, "high technology" products exhibit complexity in the product itself, its manufacturing process, and the enabling infrastructure necessary to operate and sustain it. Sometimes, both high and low technology alternatives can be employed to address the same problem. For instance, nearly 2.1 million people die each year from vaccine-preventable diseases, often because the vaccines cannot be transported without refrigeration [21]. Social enterprises like Nanoly are developing nanotechnology polymers to create heat-resistant vaccines [22]. At the same time, low-tech products like a refrigeration flask that provides 24 hours of refrigeration after being heated for 30 minutes are also being developed. However, even this low technology shows that the high-low dichotomy is not as strict as it seems, because the flask is based on the results of complex computational fluid dynamics simulations [23].

In other words, high-tech solutions can lead to simple low-tech products that are more likely to be sustainable in low-resource contexts. At the same time, leapfrogging technologies like cell phones and solar power systems might present viable and highly-scalable solutions. Rather than building and maintaining roads across the African continent, low-cost airlines might be a more practical and cost-effective solution. Further, an extremely high-tech endeavor has the potential to transform into a ubiquitous technology. GPS navigation systems, developed for military and aeronautic operations at the cost of billions of dollars, are easily affordable and find applications in a variety of poverty alleviation endeavors. GPS devices are as excellent example of a high technology that has become so ubiquitous that people don't regard it as high-tech anymore.

Is it More Important for Technologies to Be Affordable or Durable?

Engineers sometimes face a conflict between minimalist, low-maintenance, short-term solutions and more complex, expensive, but long-lasting ones. These decisions need to be informed and tempered by consumer expectations, socioeconomic conditions, access to capital, and cultural preferences, among other factors. Do consumers want an inexpensive device that must be replaced every year or a more expensive device that will last longer but that requires repairs? Are the resources needed for repairs available? Is it easy to acquire a loan for a longer-lasting product or is it easier to continually save money for consumable items?

One way of balancing repair needs versus lifecycle is to incorporate maintenance requirements directly into the core of the social venture. SELCO, a social enterprise in India, provides personalized solar power systems for customers with routine maintenance integrated into product costs [24]. While the initial costs may be higher, this approach ensures that the solar systems are maintained by trained technicians and continue to meet the needs of customers. Other social enterprises develop their technology under a "do-it-yourself" methodology to encourage end-users to understand the product and take responsibility for maintenance. The challenge is that required tools are

not available in many areas and do-it-yourself culture is not as common in developing communities, especially for more expensive products. Another approach is to implement consumable solutions, such as the disposable, point-of-use water filters being used in several developing countries [25]. Pay-for-use business models, where customers only pay for product usage (e.g., paying for power rather than a solar panel) alleviate the challenge of access to capital and essentially side-step the affordability/durability debate.

Should We Promote Economically-Beneficial Technologies that Hurt the Environment?

Although eco-friendly technologies and manufacturing processes are preferred, they can be too expensive and hence unaffordable to people in developing countries. For example, in Kenya, entrepreneurs use car batteries to operate small businesses that recharge cell phones, power street telephone businesses, or entertainment centers offering TV viewing services. Car batteries are environmentally toxic but are essential for these small businesses to survive. Without the batteries, these individuals would likely be relegated to subsistence farming or the unreliable ad hoc labor market. Instead, they are using environmentally-toxic technology to improve their livelihoods. Ideally, car batteries could be replaced by solar or other renewable energy sources, but these technologies are often too expensive to be viable. Also, improved livelihoods engender a respect for the natural world and thoughtful use of resources.

Another option for environmentally-conscious ventures is reusing detrimental materials in benign ways. For instance, some entrepreneurs embrace the inability of plastics to biodegrade by incorporating them into longer-lasting structures. Entrepreneurs in Lesotho are using plastic bottles to make mini-greenhouses for individuals that cannot afford traditional greenhouses [26]. The bottles have already been used and discarded from their original purpose, so reusing them in the greenhouses (which need some sort of clear plastic-like material to function) is actually a relatively benign approach for creating social good. The key point in these situations is that technology products may benefit from resources that are not environmentally benign. While it is best if the toxic materials are recycled for these applications, ventures must decide for themselves if they can accept environmentally toxic resources as unfortunate byproducts to the social value created. In any instance, developers should comply with local policies and endeavor to find cradle-to-cradle solutions for their products.

Appropriateness and Tradeoffs

As the pursuit of appropriate technology continues, the theory and tenets for its appropriateness will no doubt continue to develop. However, innovators must realize that all of these tenets are in fact tradeoffs — questions that each technology venture and set of stakeholders must answer for themselves. These engineering design and implementation questions span the spectrum from cultural to financial to manufacturing and capital issues. The answers must be tailored to the context of the problem, the desired solution, the appropriate business strategy, and the preferences of the stakeholders. To ensure that a technology achieves economic, social, environmental, and technological sustainability, developers must engage in open discussions with local partners. Communities should have a voice in these decisions to ensure that the designs meet their needs and result in a self-determined improvement of livelihoods and agency. However, engaging the community in every single aspect of the venture can lead to expectations and ownership, which although desirable, have the potential to negatively impact the success of the venture and limit its scalability [27].

Beyond all the systemic design and implementation tradeoffs is the fundamental question upon which all the others rest — should outsiders create solutions for the developing world? Why is the appropriate technology movement trying to develop these solutions? What if it hurts the cultures and countries instead of helping them? One answer is to consider Humanitarian Engineering a new wave of cultural imperialism: the West is trying a new mechanism of imposing its ideal worldview on poor countries. This is a valid viewpoint and perhaps true for some. An alternate perspective, and one that we prefer, is to think of AT as an exercise in co-creation. If we espouse the principles of empathy, equity, and ecosystems when we engage with people across the world, the distance between "us" and "them" vanishes. As illustrated in this article, we live in an interconnected world with complicated problems, dwindling resources, and shared solutions. It is imperative to break down the barriers between our disciplines, cultures, and epistemologies to find practical, innovative and sustainable solutions. A few ventures will be successful while many will fail. Cultures are robust enough to survive our spectacular failures while the world is waiting to celebrate and adopt the successful game-changers that improve the human condition.

Author Information

The authors are with the Humanitarian Engineering and Social Entrepreneurship (HESE) Program at The Pennsylvania State University, State College, PA 16801.

References

[1] P. Dunn, *Appropriate Technology: Technology With a Human Face*. New York: Schocken, 1979.

[2] "Husk Power Systems," *Appropriate Technology*, vol. 38, no. 3, pp. 60–63, 2011.
[3] S. Srinivas and C. Jalajakshi, "Alternatives to micro-irrigation: Evaluation of the treadle pump," *Economic and Political Weekly*, vol. 39, no. 38, pp. 4271–4275, 2004.
[4] B. Hazeltine and C. Bull, *Field Guide to Appropriate Technology.* London, U.K.: Academic, 2003.
[5] W. Easterly, *The White Man's Burden: Why the West's Efforts to Aid The Rest Have Done So Much Ill and So Little Good*. New York, NY: Penguin, 2006.
[6] A. Alesina and D. Dollar, "Who gives foreign aid to whom and why?," *J. Economic Growth*, vol. 5, no. 1, pp. 33–63, 2000.
[7] J. Cohen and P. Dupas, "Free distribution or cost-sharing? Evidence from a randomized malaria prevention experiment," *Quart. J. Economics*, vol. 125, no. 1, pp. 1–45, 2010.
[8] M. Edberg, *Essential Readings in Health Behavior: Theory and Practice*. Sudbury, MA: Jones and Bartlett, 2010.
[9] J. Sachs, *The End of Poverty: Economic Possibilities for Our Time*. New York, NY: Penguin, 2005.
[10] Sustainable Health Enterprises, "Frequently asked questions about sustainable health enterprises (she)," 2010; http://she28.sheinnovates.com/sheSpeaksFAQS2010.pdf.
[11] R. Kaplinsky, *The Economies of Small: Appropriate Technology in a Changing World*. London, U.K.: Intermediate Technology Press, 1990.
[12] R. Kaplinksy, *Inappropriate Products and Techniques in UDC's: The Case of Breakfast Foods in Kenya*. Nairobi, Kenya: Univ. of Nairobi Press, 1978.
[13] N. Postman, *Technopoly: The Surrender of Culture to Technology.* New York, NY: Vintage, 1993.
[14] S. Jain, "Standardization of international marketing strategy: Some research hypotheses," *J. Marketing,* vol. 53, no. 1, pp. 70–79, 1989.
[15] P. Polak, *Out of Poverty: What Works When Traditional Approaches Fail*. San Francisco, CA: Berrett-Koehler, 2009.
[16] I. Sijali and M. Mwago, "Money Maker Pumps: Creating Wealth in Sub-Saharan Africa." Washington, DC: World Bank, 2011.
[17] R. Malkin, "Barriers for medical devices for the developing world," *Expert Rev. Medical Devices,* vol. 4, no. 6, pp. 759–763, 2007.
[18] *Guidelines for Health Care Equipment Donations.* World Health Organization, Washington, DC, 2000.
[19] E. Steenkamp, et al., "How perceived brand globalness creates brand value," *J. Int. Business Studies*, vol. 34, no. 1, pp. 53–65, 2003.
[20] C. Freeman, J. Clark, and L. Soete, *Unemployment and Technical Innovation: A Study of Long Waves and Economic Development*. Westport, CT: Greenwood, 1982.
[21] *Vaccine-Preventable Diseases*. World Health Organization, Washington, DC, 2006.
[22] Nanoly, "What we do," 2013; http://www.nanoly.info.
[23] A. Grosser, "A mobile fridge for vaccines," in *Proc. TED2007*, 2007.
[24] R. Rao, "Lighting up the lives of the rural poor," *Appropriate Technology*, vol. 39, no. 2, pp. 40, 2012.
[25] P. Smit, "Stellenbosch University scientists patent tea-bag-like water filter," *South Africa's Engineering News*, 2010.
[26] M. Fairs, *Green Design: Creative Sustainable Designs for the Twenty-First Century*. Berkeley, CA.: North Atlantic, 2009.
[27] A. Grzybowski, B. Mathias, and K. Mehta, "When participatory research and business strategy collide: Lessons from base-of-pyramid ventures," *presented at NCIIA Ann. Conf.*, San Francisco, CA, Mar. 2012.

Call for Nominations: IEEE Society on Social Implications of Technology Board of Governors

Deadline for 2015 nominations: April 14, 2014.

SSIT seeks nominations for three positions on the SSIT Board of Governors, 2015-2017 term.

Nominations may be submitted to Jerry Engel, SSIT Nominations Chair, at gengel64@aol.com. Please send full name of nominee with an active email address. Self-nominations are welcome.

Digital Object Identifier 10.1109/MTS.2014.2309015
Date of publication: 10 March 2014