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Research and Development Strategies for Innovations that Alleviate Poverty

Abstract
This paper explores how design schools can collaborate with government departments, nongovernmental organizations, and communities to develop solutions that enhance the lives of people living in poverty. Universities with the capacity for practice-led research can play a central role in ensuring that people living in poverty benefit from innovation processes through critical collaborations and the development of effective curriculum.

Recognizing that innovation occurs within social systems, this study highlights the research and development strategies of two design organizations working with marginalized communities. By comparing the two case studies, it is argued that innovation practices have the capacity to create micro-economies of knowledge, value, and technique (Dearden & Rizvi, 2008). The analysis also critically investigates the inter-relationships between poverty and inequality present when organizations innovate to alleviate poverty.

Introduction

In an increasingly globalized world, some engineers have begun considering how their discipline can be used in a more ethical fashion and as a result have begun creating innovations aimed at alleviating the effects of poverty. Broadly speaking, these engineers engage in practice-led research by developing solutions to problems that differentially affect people living in poverty or by collaborating with designers from marginalized communities. Business strategists (Hart, 2007; Prahalad, 2009) suggest that these novel innovation strategies can invigorate emerging markets at the 'bottom of the pyramid', whilst Polak (2008) argues that designers should be using their skills with the intention of innovating 'for the other 90%' as rightly designed innovations can produce significant quality-of-life gains for the world's poorest people.

Innovating for People Living in Poverty

Professional engineering activities for poverty alleviation fall roughly into three categories:

- Providing core public services such as water and energy;
- Addressing priority vulnerability areas like disaster risk reduction, and
- Creating markets through social businesses and entrepreneurship.

Historically engineers designing within marginalized communities note the failed technological innovations that litter international development history. Starting with this lens, the engineering process involves identifying a problem, which they will attempt to solve by applying their engineering skills to task oriented objectives. For example, they may note that the problem marginalized communities often face is the lack of basic services such as clean water and reliable energy sources (Mihelcic, et al., 2009). The task then becomes to provide off-season irrigation or filter 20 liters of water per person per day to a potable standard. By 'tinkering' with various problems, engineers might find themselves finding new ways to use spare bicycle parts, repurposing existing materials

to provide greater benefit for people, or developing a plethora of sanitation technologies. Each of these engineering solutions might produce a positive benefit for their intended audience; however, these ad-hoc engineering solutions for various problems often fail to effect systematic change.

Primarily, the gap between innovation and community transformation is because engineers develop work in a creative vacuum, with little or no consultation with the intended users (Cornwall, 2000; Dearden & Rizvi, 2008; Hickey & Mohan, 2004; Luck, 2007). It is noted that engineering activities aimed at alleviating poverty frequently involves designing for a stranger (Wiodiczko, 1999) rather than as a result of responding to a lived experience, as professional engineers rarely find themselves living in poverty. This approach situates power and agency amongst professionals rather than with local communities (Chambers, 2005), where the intended audience are passive recipients of charity, rational consumers operating within a scope of choices, or active citizens within socio-technical systems (Cornwall, 2000).

This traditional approach of designers places their work at loggerheads with international development professionals concerned with community-centered development where definitions of poverty are located within theoretical wellbeing frameworks (Gough, et al., 2007). The wellbeing frameworks situate diverse definitions of poverty such as basic needs, human capabilities, basic freedoms, sustainable livelihoods, and happiness over time in a unified model (Bevan, 2007; Gasper, 2007; White, 2009). Unanimously they include the right of a community to be active participants in decision-making process that will affect their lives. The wellbeing frameworks have flexibility to privilege the analytical frame that makes sense in a particular situation while encouraging designers to be mindful of the design context. Additionally, the wellbeing frameworks define wellbeing processes as "the interplay over time of: goals formulated, resources deployed, goals and needs met, and the degree of satisfaction in their achievement," a definition that connects closely to engineering design processes (McGregor, 2007, p. 337).

Several development scholars (Cornwall, 2000; Dearden & Rizvi, 2008; Hickey & Mohan, 2004) advocate for design teams to critically evaluate their community engagement strategies to better involve users as co-designers. Advocates for participation stress repeated contact within communities to gain trust and learn which issues the community considers important (Dearden & Rizvi, 2008; Hickey & Mohan, 2004; Luck, 2007).

I approach this research first and foremost as an engineer deeply committed to ethical engineering practice. The innate limitations of engineering design and the complexity of sociotechnical systems warrant critical reflection on both problem formulation and solution suitability (van de Poel & van Gorp, 2006). Engineering design flows from regular technological criticism (Petroski, 1996). Critics of modern industrial practices (Anderson & White, 2009; Hart, 2007; Leonard, 2010; Schumacher, 1973) advocate that designers must move away from the take-make-waste forms of production and pursue more socially just forms of design. Engineers benefit when they learn how to ask meaningful questions, identify critical similarities and differences between contexts, and read widely (Dym, 1999; Mosse, 2011; Nolan, 2002). I regard finding gaps, weaknesses, oversight, and selective logic present in existing solutions to be part and parcel of engineering practice. Designers alone cannot solve poverty. They need to be working in partnership with other actors that can help engineers, blinded by their privilege acquired through hegemonic discourses, navigate the terrains of poverty and inequality.

Studying Real Practice

To understand how designers can work collaboratively with communities on projects that have the potential to alleviate poverty two case studies are considered. The first project discussed is International Development Enterprises (IDE), a charity founded by Paul Polak. The aim of IDE is to increase the incomes of smallholder farmers and is the result of work that Polak undertook with the poor farmers in Bangladesh (McNeil Jr, 2011). He distributed affordable irrigation products that visibly improved the livelihoods

of farmers. As a result of the success he achieved, IDE established a presence in 10 developing countries on three continents. For Polak, developing innovations that alleviate poverty necessitates a design revolution where businesses create radically affordable products (Polak, 2008). IDE is a non-government organization with a year-round presence in 14 countries, focuses on stimulating markets through customer-centered, demand-driven design.

The second project discussed is International Development Design Summit (IDDS), a month-long participatory conference founded by Amy Smith to develop technologies with a global community of designers. Smith's four years in Botswana as a Peace Corps volunteer left an indelible impression that context matters in engineering design. She saw how designs installed in developing communities stopped working after donors left. Smith invented both an electrical system and a grain mill for her community, winning the National Collegiate Inventors' Prize and the Lemelson-MIT prize (Lemelson Prize, 2011). She started IDDS in 2007 to bring together innovators developing appropriate technologies. At the conference designers generate prototypes that can be manufactured and maintained in marginalized communities.

Each organization relies on networks within marginalized communities to deliver timely and appropriate innovations and both IDE and IDDS have a strong desire to develop successful innovations for the world's poorest people.

IDE: Creating Shared Value with Marginalized Consumers

Design Ethos

Generally, IDE invites designers to solve problems encountered by farmers living in poverty. For example, IDE Zambia recently launched an IDE branded pump to serve smallholder farmers designed by Peter Elkind of IDE.[1] Twenty Zambian farmers field-tested these pumps and offered performance feedback.[2] IDE values market-led solutions and has created specialized surveys to learn about marginalized customers. IDE's broader Rural Prosperity Initiative includes "gender-specific Voice of Customer surveys to determine the necessity and value of gender-appropriate micro irrigation technologies and/or adaptations."[3] IDE develops products that allow smallholder farmers to increase their incomes by increasing high-vale crops (Polak, 2008). Several IDE firms have partnered with universities to develop consumer products. Stanford's course entitled *Entrepreneurial Design for Extreme Affordability* has developed pumps, water storage systems, rice fertilization techniques, and waste management strategies for IDE affiliates.[4] Harnessing the energy of designers to increase incomes of people living in poverty appears at the heart of IDE's design ethos.

Other examples of projects undertaken by IDE include the IDE Cambodia's Farm Business Advisor program, which was awarded the inaugural "Creating Shared Value" prize by the Nestle Corporation in 2010. This program involved recruiting farm business advisors to work with local farmers as a way of strengthening Cambodian agriculture. Traditionally, poor farmers rely heavily on seasonal income from rice farming instead of capitalizing on existing market demand for locally produced vegetables. The advisors worked with farmers to educate them on the value of growing seasonal vegetables in spare land with high quality seeds. The intention behind providing the free training was to ensure that the profit gained from growing and selling locally produced vegetables through partnering with other local farmers would have the effect of increasing everyone's income and support self-sustaining businesses.

IDE values sharing its practical business knowledge with people living in poverty. In the Farm Business Advisor program, IDE Cambodia offers free enterprise training in hopes

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[1] http://www.ideorg.org/OurResults/SuccessStories/Mosi.aspx.
[2] http://blog.ideorg.org/2009/02/18/appropriate-technology-update/
[3] http://www.ideorg.org/OurMethod/Gender.aspx
[4] See http://extreme.stanford.edu/ (Success Stories, Current Projects, Continuing Projects)

of generating sustainable businesses.[5] IDE's training focus has been extended to other countries including to vegetable farmers in Zambia,[6] coffee farmers in Honduras,[7] and well diggers in Ethiopia.[8]

IDE Cambodia has also been successful at stimulating latrine production businesses. The World Bank awarded IDE Cambodia with a sanitation grant to help Cambodia achieve development goals for sanitation.[9] IDE designers partnered with a design consultant to create an integrated business model using specialized molds to streamline production processes. An aggressive marketing campaign led by IDE has sold over 10,000 latrines.[10] Therefore, IDE provides knowledge-based support expecting participants to leverage their own assets to create viable businesses.

Community Engagement
IDE views people in poverty as consumers making rational business choices and functions as a catalyst for local manufacturing firms when possible. While Polak (2008) exhorts designers to "talk to the people who have the problem and listen to what they say" and "continue to learn from your customers," IDE employs standard methodologies to uncover market opportunities with predictable barriers (International Development Enterprises, 2007). The market opportunities center on smallholder farms as IDE[11] asserts, "more than 70 percent of the world's poorest people are small scale farmers." Al Doerksen,[12] IDE's Chief Executive Director, and Mike Roberts,[13] Director of IDE Cambodia, agree that IDE should treat people living in poverty as customers, not as recipients of charity. Roberts[14] explains, "If I have to convince someone to purchase something, then my success is absolutely dependent on listening to them, understanding them, and responding to their highest priority needs."

IDDS: A Global Family of Designers Working in Marginalized Communities
Design ethos
IDDS relies on the organic potential of collaborative, participatory design to produce innovations that help people living in poverty achieve wellbeing objectives. The first summit in 2007 invited a global community of designers to produce prototypes with MIT students in Massachusetts.[15] However the decision to move the summit to the Kwame Nkrumah University of Science and Technology (KNUST) in Ghana in 2009 and 2011, permitting summit attendees to work alongside villagers. Being in Ghana allowed the summit organizers to focus on co-creation with artisans as co-designers.[16] 27 local artisans participated in the 2011 event.[17] Participants work on teams to create design, integrating feedback at all stages of the design process. By gathering designers from around the world, IDDS hopes for a global impact as designers return to their communities. Co-creating designs with skilled technicians and other villagers appears to represent the core of IDDS's design ethos.

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[5] http://www.ide-cambodia.org/fba/
[6] http://www.ideorg.org/OurResults/SuccessStories/Veronica.aspx
[7] http://www.ideorg.org/OurResults/SuccessStories/Honduras.aspx
[8] http://www.ideorg.org/OurResults/SuccessStories/WaterAndWork.aspx
[9] IDE's Sanitation Marketing Project Honored by World Toilet Organization, accessed at http://www.ide-cambodia.org/download/WTO_Hall_of_Fame_Press_Release.pdf
[10] http://www.ide-cambodia.org/index.php/projects#sani
[11] www.ideorg.org/OurMethod/Water.aspx
[12] http://blog.ideorg.org/2010/06/29/ide-has-no-beneficiaries/
[13] http://blog.ideorg.org/2011/01/20/success-its-in-the-toilet/
[14] http://blog.ideorg.org/2010/08/24/creating-value-at-farm-level/
[15] Andrew Revkin, "Low Technologies, High Aims" http://www.nytimes.com/2007/09/11/science/11mit.html
[16] Niall Walsh, "The Importance of Being in Ghana" http://www.afrigadget.com/2009/08/11/final-presentations-at-idds-ghana/
[17] David Chandler, "In the World: Design summit's inventions find willing buyers." http://web.mit.edu/newsoffice/2011/idds-0826.html

IDDS brings together a range of capable designers, recognizing that knowledge emerges from collaboration. Participants themselves identified potential projects before being organized into teams; each summit features ten active projects that articulate the breadth of design skills. Projects have included treating of breast milk to prevent mother-to-child transmission of HIV/AIDS and a gravitational ropeway for transportation. No single person can be credited with the success or failure of any technological effort. The conference succeeds when designers return to their home contexts empowered with greater skills.

IDDS values jointly constructing solutions to problems that differentially effect people living in poverty with designers from marginalized communities. The global network includes academics, students, professionals from private businesses, and designers working with non-governmental organizations. Smith's extensive connections in the global South allowed her to have a global summit even as advertising relied significantly on word-of-mouth and personal invitations.[18] IDDS organizers networked with funders to provide financial assistance so designers from marginalized communities could attend the summit. Universities with the capacity for practice-lead research provide workshop space and housing for participants. Summit design teams focus on producing prototypes, receiving feedback in scheduled design reviews. The host university significantly influences the character of the event. MIT's dedicated lab spaces for prototyping invite skilled technicians to share skills.[19] KNUST has a partnership with Suame Magazine, greatly improving the connection with local artisans.[20] Colorado State's Global Social and Sustainable Enterprise program supported creating business plans.[21]

Community engagement
IDDS frames poverty in marginalized communities as collapsing technical solutions. Innovations removed from local expertise and capabilities fail because these innovations remain separate from the community. Therefore IDDS networks with designers living in communities all over the world during a month-long design workshop. The summit copes with natural constraints of geographic proximity. When designers stay in a village,[22] they use various strategies such as open community meetings,[23] intentional discussions with specific community members, and participant observation.[24] Summit organizers leverage social connections of a growing network, constantly building new relationships. Local elites have a significant role in providing access to communities.[25] Collaborative design efforts act to democratize knowledge, honoring the expertise of skilled artisans. Innovators use the Summit to critique existing innovations and refine business models.[26] Because the Summit operates as a one-month event, many attendees use the time at the Summit to discuss problems encountered since the last event.

Comparing IDE and IDDS
IDE and IDDS use different research and development strategies to create innovations for people living in poverty. These strategies stem from practice-led constraints as the organizations deliver innovations to people living in poverty. Both IDE and IDDS have

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[18] Jonathan Greenblatt, "South-South Design Flourishes at MIT Summit" http://www.worldchanging.com/archives//007106.html
[19] Felicia Mello, "Fast, Cheap, and in Control" http://www.boston.com/news/education/higher/articles/2007/08/09/fast_cheap_and_in_control/
[20] http://iddsummit.blogspot.com/2009/07/taking-trip-to-suame-magazine.html
[21] http://iddsummit.org/featured/learning-to-un-build-and-mapping-out-the-quest
[22] http://iddsummit.org/featured/off-to-the-villages-2
[23] http://iddsummit.blogspot.com/2009/07/village-visit-1-destination-new-longoro.html
[24] http://iddsummit.blogspot.com/2009/07/village-visit-two-destination.html
[25] http://iddsummit.blogspot.com/2009/08/village-visit-three-back-to-new-longoro.html
[26] http://www.nextbillion.net/blog/2010/08/05/colorado

important relationships with existing universities. Table 1 summarizes some of the key similarities and differences between IDE and IDDS.

	IDE	IDDS
Organizational structure	A non-governmental organization with a permanent presence in 14 countries	A month-long design workshop hosted at university locations in the summer
Definition of poverty	Result of limited earning potential and lack of affordable products	Collapsing technical solutions in marginalized communities
Design ethos	Harnessing the energy of skilled designers to address problems of people living in poverty	Collaborative participatory design working with designers from marginalized communities
Technologies developed	Specific farm technologies with some expansion into household products	Broad portfolio of technologies proposed by summit participants
Community engagement	Largely driven by market research, catalyzing business activities, and customer satisfaction; evidence of some evaluative field testing	Intentional, if haphazard, community participation with accessible villages
Types of university partnerships	Collaboration with design schools to develop or improve specific technologies around problem statements	Network includes several university faculty overseeing various service-learning programs and/or research centers developing technologies for marginalized communities

Table 1: Comparing IDE and IDDS

IDE and IDDS differ in their design ethos. IDE consolidates expertise within the organization, relying on outside consultants only when necessary. By contrast, IDDS wants every participant to gain confidence and knowledge relevant to design challenges encountered in the various home communities. IDDS reflects a greater participatory ethos as participants propose design challenges for the summit so that the whole group can vote on which products get developed. An organization's design ethos influences what problems the organization deems to be important and how the organization develops innovations. IDE develops solutions for large problems that differentially effect people living in poverty while IDDS creates more niche prototypes to enable designers working in marginalized communities to solve specific problems.

IDE and IDDS employ different strategies to engage communities. IDE pursues programs that teach villagers IDE's business strategies and agricultural techniques. By contrast, IDDS features intentional spaces to learn directly from villagers. When IDDS designers visit communities, the designers attend open community meetings to receive feedback and input. IDE presents villager engagement as a rational choice stemming from a desire to increase income. Both strategies raise questions about elite capture (Platteau, 2004) and engaging effectively with the poorest members of communities. IDE expects people living in poverty to leverage held assets. Designers from marginalized communities need to travel to attend IDDS, and the summit organizers rely on local elites to gain access to communities. Organizations working to improve the wellbeing of people living in poverty must critically reflect on their community engagement strategies to be mindful of the different limitations of various techniques.

While both organizations show evidence of innovating for poverty alleviation, the organizations have pursued remarkably different innovation trajectories. To understand the impact of these innovation processes, both organizations would benefit from using rigorous theoretical frameworks that enable direct comparison. Wellbeing frameworks permit comparable impact analysis because these frameworks include assessments of multidimensional poverty, guide designers towards key innovation objectives, and enable community participation.

The *social construction of technology* (SCOT) provides a comprehensive theoretical frame to analyze innovation practices. SCOT assumes "every technology is deeply embedded in a continual (re)construction of the world" (Nye, 2006, p. 61). This

framework acknowledges the complex inter-workings in sociotechnical systems. Broad discourses of political priorities, economic conditions, social networks, ecological demands, and technical knowledge constrain, enable, empower, and create opportunities for technological innovation (Eglash, 2004; Hughes, 2004; Pfaffenberger, 1992; Pinch & Bijker, 1984; Schot & de la Bruheze, 2003). Further, SCOT analyses *complex systems* to acknowledge the many actors, both human and nonhuman, present in real-world activities (Highmore, 2009; Lindsay, 2003). Analysis of innovation practices fits within SCOT because this framework considers the *construction* of technologies while providing space to consider unintended effects. In positioning innovation efforts within broader discourses, it also allows for the structural rules of engagement for each organization to be interrogated (Klein & Kleinman, 2002).

Implications for Universities

Universities with capacities for practice-led research can shape positive innovation trajectories through direct research collaboration, intentional service-learning programming, and critical research to evaluate innovation claims. Through broad partnerships with existing design firms like IDE and IDDS, universities could develop innovations that positively and differentially benefit the world's poorest people. Novel service-learning models could help students connect directly with marginalized communities. Engineers working in marginalized communities often present their innovations as successes even when a design needs considerable improvements (Chambers, 2005, 2008; Crewe & Harrison, 1998). Universities can conduct critical research engaging with key stakeholders to evaluate innovation impact claims. All collaborations require design schools to acknowledge the inherent information gaps present in distributed design and limitations of evaluation frameworks.

Universities can directly engage by developing innovations for people living in poverty. Defining poverty more broadly as *the systemic failure to achieve wellbeing objectives* provides university designers with analytical frameworks for contextually informed design (Bevan, 2007; McGregor, 2007). The approach enables three primary elements for design researchers. First, it focuses on the most important expertise: the expertise that the poor people themselves bring through their lived experiences rather than on externally-based "expert" opinion ungrounded in the local context. Second, it illuminates the community dynamics (White & Ellison, 2007). Third, the breadth of wellbeing objectives that enable active community participation facilitates interaction with policy makers and enables a rich combination of wellbeing objectives that might well result from creative design brainstorming. Universities can become involved with communities, the links between communities, designers and policy makers, and better understand which elements of a wellbeing framework work in which contexts, and why.

Universities can host technological incubators developing solutions to problems encountered by people living in poverty. For example, Polak founded a technology incubator, D-Rev, to develop affordable technologies for emerging consumer markets. Technologies incubated by D-Rev currently include phototherapy for jaundiced newborns, a prosthetic knee, a microscope for clinical diagnosis, hand-held communication systems for crop information, a household solar power system, and cold pasteurization processes for milk.[27] D-Rev collaborates extensively with Stanford University. As a technology incubator, D-Rev develops marketable technologies that solve problems encountered by people living in poverty. Increasingly, universities incubate technologies within entrepreneurship competitions where students develop products that address problems encountered by people living in poverty (Estell, et al., 2010; Mehta, et al., 2010; Mehta, et al., 2011; Reid & Estell, 2011). Technology incubators provide space that allows new ideas to form, shape, incubate, and mature.

Universities have multiple options to connect students with innovating for poverty alleviation. Intentional service-learning programs, like the MIT D-Lab, can introduce students to designing for marginalized communities. D-Lab currently hosts twelve

[27] Details at http://www.d-rev.org/projects.html.

unique courses. Trips provide MIT students with experiential knowledge associated with a developing community. MIT's emphasis on hands-on learning develops D-Lab's capacity to engage with practice-led research, developing product proposals in innovations courses. Students work with community partners, like IDE, to develop technological innovations suited to the community's context. Poverty reflects both an international and domestic opportunity for engineering students. The Design School at Stanford created a class designed to alleviate poverty in America.[28] Some schools have designed complete programs to support design for poverty alleviation. Colorado School of Mines has crafted a detailed option in humanitarian engineering that serves as an exemplar for deep humanities and social science learning (Moskal & Gosink, 2007). Michigan Tech pioneered eight master's degrees[29] revolving around the Peace Corps experience of students.

Defining poverty as *the systematic failure to achieve wellbeing objectives* creates opportunities for interdisciplinary program creation. Intersecting themes of responsible wellbeing, sustainable development, social business, and vulnerability reduction provide a rich body of knowledge to guide design principles. Innovative engineering educators (Kilgore, et al., 2007; Riley, 2003; Vanasupa, et al., 2006) have suggested that design for large-scale social issues brings together technical prototyping skills and professional engineering ethics. Educators focusing expressly on design in poor communities affirm that pro-active design choices around the social and technological trade-offs can minimize the adverse effects of poverty on human wellbeing (Baillie, 2006). With the rise of social entrepreneurship and social businesses, young engineers have new opportunities to innovate for varied social missions (Yunus, 2007). Inoculating young engineering professionals with the reflexivity to translate a social mission into a critically vetted innovation requires deeply understanding the capabilities, intentions, and attitudes present in a community (Prince & Felder, 2006; Turns, et al., 2005).

The practice-led character of innovating for poverty alleviation has substantive implications for university teaching. Educators must provide scaffolds to help students who say statements like, "[Poverty] is such a broad and overwhelming topic that I feel that most of the students including myself missed your message" and "With such a broad topic of 'poverty' it was difficult for us to get a grasp on a single idea" (Estell, et al., 2010). Furthermore, engineers encounter hazards of fixating on concepts too early. While acknowledging that learning to iterate designs comes with experience, engineering design educators should be cautious of design arrogance. When completing an end-of-course survey, one student described the experience as follows:

> In less than ten weeks time, our group met, designed, assembled, and is in the process of testing a functioning prototype. Using the engineering design process, our group successfully engineered a solution to a problem half a world away. Even though our design may never actually be used in Niger, our group has discovered it is a very plausible, less time-consuming method of cooking (Estell, et al., 2010).

While this student rightly celebrates the achievements of the group associated with meeting, designing, and assembling a testable prototype, she or he extends the evaluation to a successful implementation. Equally, the instructors consider using these projects to create international service opportunities where first-year engineering students will "attempt to implement, and document the implementation of, selected designs from the first-year capstone course" (Reid & Estell, 2011). Universities developing innovations should consider their relative distance from engaging directly with marginalized communities and be cautious around design arrogance.

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[28] http://dschool.stanford.edu/classes/#design-for-change-poverty-in-america

[29] Program areas include Applied Natural Resource Economics, Biological Sciences, Civil and Environmental Engineering, Forest Resources and Environmental Science, Mechanical Engineering, Natural Hazards Mitigation, Rhetoric and Technical Communication and Science Education. Details at http://peacecorps.mtu.edu/

Universities could evaluate the impact claims of innovations. While researchers have explored some of IDE's claims about the social and economic impacts of the treadle pump (Shah, et al., 2000) and ceramic water filters (Brown & Sobsey, 2006), the majority of poverty reduction claims receive anecdotal support. Innovations require understanding wider social contexts, particularly regarding poverty (Mitchell, 2002; Smillie, 2000). Several innovations had social effects that reduced the innovation's ability to alleviate poverty. For instance, the manual labor required by treadle pumps created an imbalance in gender relations when women received the task to pump water. The PlayPump, where designers tried to encourage kids to play on merry-go-rounds that simultaneously pumped water, misread cultural realities and installed the concept in inappropriate locations (Freschi, 2010). Efforts to improve cooking technologies transformed household relationships have increased, rather than decreased, the domestic work undertaken by women (Crewe & Harrison, 1998). Observationally, these examples focus principally on gender relations; gender offers but one lens to view social change.

Conclusion

I have discussed the innovation strategies of two different organizations designing technical solutions for the world's poorest people. These comparisons highlight areas where universities with capacity for practice-led research can engage more critically with innovating to alleviate poverty and to improve the wellbeing of people living in marginalized communities. Universities can directly develop innovations, create intentional service-learning programs, and evaluate innovation impact claims.

Designers would benefit from cultivating innovation skepticism. Many innovators claim to involve the community. This involvement might be for market research or reflect local designers working on participatory design teams. Requiring people living in poverty to leverage held assets or travel extensively can raise barriers to participation and enable elite capture. While designing to price points can make a product affordable to someone living at the poverty line, the price point might be too high for people living below the poverty line. Partnering with nongovernmental organizations and government offices could be one way to improve access to the poorest people in communities. Cultivating innovation skepticism requires engaging in regular technological criticism where designers continually improve designs. By engaging with communities for substantive time periods, designers can play a key role in helping that community achieve wellbeing objectives.

Universities with capacity for practice-led research play a central role in ensuring that people living in poverty benefit from innovation processes. These universities can directly engage with innovating for poverty alleviation through designs informed by wellbeing frameworks. Collaborating with nongovernmental organizations, governments, and communities can lead to solutions that improve the lives of people living in poverty. Furthermore, students can participate intentional service-learning programs that prepare the students to engage in community-centered design. University researchers can use wellbeing frameworks to evaluate the impact claims of innovations. Effective innovation processes require long-term engagement between designers and communities.

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