

# Three Models of Development: Community Ophthalmology NGOs and the Appropriate Technology Movement

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## Abstract

This paper describes a new shift in the appropriate technology movement in less economically developed countries as seen in a multi-sited ethnography of non-governmental organizations (NGOs) in the scientific field of ophthalmology. This research reveals how Aravind Eye Care System in southern India and Tilganga Institute of Ophthalmology in Nepal are addressing “undone science” for avoidable blindness. They are creating the requisite local hospital and personnel infrastructure while conducting “civil society research.” They are also providing high quality modern care to low-income patients of the global south while charging reduced or no fees. This paper argues that they represent a third model in the appropriate technology movement—contextually appropriate local production of high technology. This third model focuses on *socially responsible innovation* for purposes of social improvement; it is rooted in non-profit, social enterprise organizations to include the following four aspects: (1) scientific innovation or the “appropriation” of new science; (2) organizational innovation, including changes in operations management for self-sufficiency through multiple revenue streams; (3) technological innovation or the creation of new products and artifacts; and (4) an underlying ideological orientation that is based on local philosophy (and challenges hegemonic understandings of postcolonial dependency or neoliberalism).

## Keywords

socially responsible innovation, NGOs, community ophthalmology, appropriate technology

## 1. Introduction

Surgery is the “neglected stepchild of global public health” (Farmer and Kim 2008), and this is a tragedy if one considers that 11% of the global burden of disease is due to unmet surgical needs (Ozgediz and Riviello 2008). Unmet surgical needs and neglected tropical diseases (infectious or parasitic diseases

that are not malaria, HIV/AIDS or tuberculosis) together might be described as *doubly orphaned diseases*.<sup>1</sup> The few global health practitioners who are looking for ways to combat such *doubly orphaned diseases* find that there is neither context-appropriate scientific research nor adequate infrastructure available to address these diseases.

Ophthalmologists in South Asia are creatively addressing unmet surgical needs and cataract disease by borrowing both the practices of socialism and the rhetoric of capitalism. These ophthalmologists are providing eye health care through innovative surgical science (Williams 2011), innovative technology, high efficiencies, and low costs. As a result of their efforts, hospital and personnel infrastructure for eye health care have been developed.

The emergence of surgical science and multinational companies around cataract disease and intraocular lenses has been previously explored as a sectoral innovation system in the U.S. and the U.K. (Metcalf *et al.* 2005). In contrast, this paper will describe an emergence of surgical science and self-sufficient non-governmental organizations (NGOs) in South Asia and their pursuit of *socially responsible innovation* in the civil society or “third sector.” This third sector is typically not examined in evolutionary economics because of its perceived lack of connection to capitalist market economy.

## 2. Developmentalism and the Appropriate Technology Movement

The appropriate technology movement started in reaction to the focus of 1950s and 1960s development professionals on transfer of inappropriate high technology from economically developed countries to less economically developed countries (Seely 2003; Willoughby 1990). It is influenced by ideology from the Indian independence movement and Buddhism (Willoughby 1990). I believe that there is a shift in the appropriate technology movement, where civil society organizations are addressing “undone science” (Hess 2007; Frickel *et al.* 2010) on a transnational stage by a process of local innovation and high technology production that is concomitant with social entrepreneurship, or what I call contextually appropriate local production of high technology. In specific terms, contextually appropriate local production of high technology focuses on technology innovation for purposes of social improvement, and it is anchored in nonprofit, social enterprise organizations.

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<sup>1</sup> World development has been shown to be closely tied to disease; the impact of communicable diseases such as HIV/AIDS and malaria on economic development and national security has been carefully investigated. However, recent studies have shown that \$19 billion dollars is lost each year in global productivity due to avoidable blindness (Frick and Foster 2003).

Developmentalism is the explicit attitude that the least economically developed countries can have substantial economic growth through a linear process of implementing modern programs which typically include technoscience transfer (Pieterse 1991). Developmentalist discourse regarding the “Third World” and “underdeveloped” countries has been traced by several scholars (Escobar 1994; McMichael 2000; Pieterse 1991; Sachs 1992). This discourse stems from the focus of Western experts and politicians on the “lack” of modernity, technology, and high-income lifestyles of countries within Asia, Africa, and Latin America (Escobar 1994).

As an ideology, developmentalism is not restricted to Western states. Variants of this expectation of linear progress through technoscientific change (and the concomitant policies) can be found in the historically communist Soviet Union (Adas 2006) and the contemporary communist People’s Republic of China (Harvey 2005). Pigg demonstrates in a pioneering study (1992) how the discourse of developmentalism has the power to organize the lives of Nepali people and shape their identities according to poles of modern/traditional while remaining uniquely specific to the Nepali historical context of development and Nepali categories of the “backwards” villager versus *bikāsi* (someone who is “developed”).

Westerners started the appropriate (or intermediate) technology movement from the 1960s onwards in opposition to developmentalist practices of high technology transfer (Willoughby 1990). However, these same activists have often been guilty of subscribing to developmentalist rhetoric. The pivotal collection of essays by Schumacher emphasized people-centered economic development based on local production of intermediate technology that was bound by “enoughness” (1973). One essay explicitly discusses right livelihood as part of the eightfold path of Buddhism (Schumacher 1973). A second essay critiques modern sophisticated Western high technology as inappropriate to the needs of developing nations with a large labor surplus (Schumacher 1973). Westerners argued that the import of high technology occurred hand-in-hand with Fordist industrial practices that replaced highly skilled individuals and good wages with machines and no jobs (Schumacher 1973). High technology imports require large capital expenditures; such imports are not necessarily the best use of scarce resources within less economically developed countries (LEDCs). Consideration must be given to the fact that capital alone will not purchase the concomitant skills necessary to maintain and repair such “high tech” equipment. Therefore, having identified high technology as inappropriate for development, the appropriate technology movement instead became interested in facilitating the design and creation of small, low-cost, locally produced technologies (Schumacher 1973). Willoughby traces how Schumacher’s economic

scholarship was influenced by Gandhi and the Indian independence movement's philosophies of *swaraj/swadeshi/sarvodaya* (self-rule/self-sufficiency/community development) and Burmese Buddhist philosophies. These South Asian philosophies encouraged Schumacher to reflect on the materialism inherent to Western economics theory and to consider whether there could be an alternative path that focused on enough growth instead of limitless growth (Willoughby 1990:50-71).

Quite early on in the appropriate technology movement, an Indian scientist commenting in the *Social Studies of Science* found that appropriate technology is often defined as unsophisticated low-tech for the Third World (Reddy 1975). Westerners who are part of the AT social movement and its offspring (such as undergraduate programs in engineering and development in the U.S.), despite their good intentions, are often guilty of subscribing to such developmentalist rhetoric that categorizes technological development for less economically developed countries as necessarily low-tech. Since the 1970s, the appropriate technology movement has focused on "low" or "intermediate" technology that is appropriate to the local social context. For example, Engineers Without Borders—U.S.A. (EWB-USA), which started in 2002, has a mission statement that indicates their interest in designing "low-cost, small-scale, replicable and sustainable engineering solutions to problems identified by the community."

Every international development organization with a technology transfer success story also has a slightly different definition of what an appropriate technology is, and yet together these definitions add up to a universal design context of "low-tech for the Third World." Willoughby, in his 1990 critique, found fault with the multitude of definitions of what an appropriate technology as artifact could be. Instead, he created a unified theory of appropriate technology; Willoughby argued that a technology can only be considered appropriate if it has been tailored to fit the dynamic and specific biophysical and psychosocial context that it will inhabit. This theory, called "technology choice," was a great attempt to avoid the pitfalls of a universal design context of low technology in LEDCs.

Also problematic, the appropriate technology discourse presents a singular solution (an artifact) to fix a systemic problem (infrastructure creation and maintenance). It is possible that "successful grassroots development in the global economy will have to entail local control of high technology—and not merely its use, but its production. Native peoples must be seen . . . as those who control the means of their production" (Hess 1995: 248). This emphasis on local production and control of high technology is a little different from what Schumacher and others in the original appropriate technology movement believed

possible. However, this argument has the advantage of re-focusing from the singular appropriate technology solution to the control, use, and production of a variety of interlocking innovations. Thinking of how to address issues of social injustice through interlocking innovations may be necessary for self-sufficient economic development by NGOs—as neither the first model of transferring high technology, nor the second model of local production of context appropriate low technology, has proven entirely adequate for infrastructure and economic development within less economically developed countries since the 1960s appropriate technology movement.

### 3. Neoliberal Globalization and Undone Science

Neoliberal globalization has caused deregulation; NGOs often fill the gap left by the withdrawal of governments and centrally planned services (Harvey 2005; Kamat 2002). “Epistemic modernization” is a countervailing phenomenon to neoliberal globalization where there are opportunities for NGOs (and social movements) to participate in science regulation and in knowledge production in ways that they historically were unable to do as part of civil society (Hess 2007; Moore *et al.* 2011). The Third Sector (civil society sector) has become a site for innovation under neoliberal globalization with some NGOs beginning to change from their more traditional roles into social enterprises. Williams and Woodson (2012) argue that some non-governmental organizations have taken on attributes of governments (i.e., by providing essential services, defining policy and planning), firms (i.e., controlling capital flows and using market economies of scale) and/or universities (i.e., they teach experts and create organizational linkages).

Neoliberal globalization has also caused the scientific field to be unevenly developed, resulting in “undone science” (Hess 1998, 2007). Undone science is the scientific knowledge that is absent due to the passive and active pressures of research agendas set by government and industry funders (Frickel *et al.* 2010; Hess 2007, 2009). The benefit of an increasingly market-based context for producing scientific knowledge is that innovative work is incentivized to reach the public more quickly. The disadvantage is that the market context of research favors the production of knowledge for those who can afford it; thus the “public” who primarily benefit are middle- and high-income consumers in the West. Hess suggests that the scientific field has undergone uneven development resulting in done versus undone science, where research in some fields is prioritized for military and industrial elites rather than for groups with

historical problems of disempowerment and/or poverty (Hess 2009:308-309). For a variety of reasons scientists often do not investigate alternatives in order to determine which science best fits the sociocultural and economic context of the particular place where it will be deployed and the constraints imposed by the particular disease or problem being addressed. Often alternative sciences remain undervalued and/or under-researched as demonstrated by Turnbull's discussion of the "push" for the malaria vaccine instead of mosquito nets or DDT (1989); Woodhouse's discussion of continued chemical research using petroleum-based instead of "green" chemistry (Woodhouse *et al.* 2002; Frickel and Moore 2006); and research on ideologically biased regulatory regimes defining appropriate evidence for chlorine regulation (Frickel *et al.* 2010:10). In these examples "the problem of undone science' [is] the possibility of systematic distortion of a field's (or even a society's) total research portfolio" (Hess 2007; Woodhouse *et al.* 2002:304). However, what about undone technology (Woodhouse's personal communication) or undone management techniques? This spectrum of undone innovation needs to be addressed systematically, especially because the multifaceted nature of some problems may require a variety of interlocking innovations to solve them.

There is the potential for countervailing forces in the scientific field to address these knowledge gaps in often highly contested processes (Hess 2007, 2009). Feminist standpoint epistemology or "science from below" suggests that those within marginalized groups have a unique perspective on scientific knowledge because of their social location, which allows them to expose the unrecognized ideological biases of mainstream scientific knowledge production (Harding 2008). When those standpoints are incorporated (i.e., through recruitment of women into the scientific field), the result is an improvement or strengthening of objectivity in the research field (Harding 2008). When those standpoints are not included in the scientific field, they can still become part of a research field if civil society organizations identify the "undone science" and conduct the necessary "civil society research" (Hess 2009; 2010:3).

Civil society research (Hess 2009; 2010) is one way that undone science is addressed. While civil society organizations performing research is not necessarily new, the practice of marginalized (i.e., non-Western) self-sufficient NGOs performing their own civil society research on the economic periphery of modern science is an interesting and underexplored phenomena. In general, NGOs are driven by a humanitarian mission, but some of them, while not necessarily self-described as part of the appropriate technology movement, are producing appropriate high technology and modern science as well as new modern management practices. In this paper, I describe how this has been

done by community ophthalmology NGOs through this third model of contextually appropriate local production of high technology, where

Both NGOs and their clients are active subjects of the neoliberal project, not simply subjugated by hegemonic forces. Some employ a complex mixture of acquiescence, strategic subversion and resistance to achieve, in part, their goals and desires. Moreover, some people in the South, sometimes in pursuit of wider visions, and sometimes seeking individual, material needs, make spaces by using NGOs. This is not true of all NGOs or all clients, but some NGOs are making contributions, however small, to alternative visions of change. (Townsend, Porter, and, Mawdsley 2004:872)

The personal and structural relationships between NGOs (in the world's economic periphery of modern science) and their donors (in the resource-rich centers of scientific knowledge production) distinguish self-sufficient NGOs from externally funded NGOs in their attempts to contribute to alternative visions of science, technology and development. Shrum (2005) discusses the personal and structural relationships between "guests" (visiting scientists from industrialized countries bringing resources) and "hosts" (domestic organizations conducting scientific research in LEDCs) as "re-agency." He defines re-agency as "a contingent redirection of action involving identities... [where] notions of identity and place are required to understand how a particular kind of agency is produced in distant lands... Re-agency describes, better than development, what happens when organizational representatives from afar enter countries with agendas and initiatives. Discourse and resources are mobilized to receive initiatives, transmuted on location and repackaged for evaluative, reporting, and 'participatory' requirements" (Shrum 2005:724-726).<sup>2</sup> Thus domestic NGOs (or "hosts") operating in less economically developed countries exist somewhere along a continuum from accountability to efficiency (Harsh, Mbatia, and Shrum 2010).<sup>3</sup> Where they fall along this continuum depends very much upon their relationship with their donors or "guests,"

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<sup>2</sup> The identities involved in re-agency are organizational (i.e., USAID or World Bank; Harsh, Mbatia, and Shrum 2010:259). Harsh, Mbatia, and Shrum argue that by examining re-agency, scholars can step back from both instrumental (normative) and critical studies of "NGOs and development" to instead focus on cross-national resource transfers (2010:255, 258). Studies of cross-national resource transfers and the resultant activities offer new insight into the constraining and enabling practices of NGOs doing "development" in comparison to: (1) normative studies of increasing transparency and democracy or; (2) critical studies of how NGOs reproduce inequality (Harsh, Mbatia, and Shrum 2010).

<sup>3</sup> As an NGO moves left to right from accountability towards efficiency along this continuum, its resources are mobilized increasingly for disbursing services instead of creating reports or targeting specific constituents (Harsh, Mbatia, and Shrum 2010).

which might be foreign NGOs from industrialized countries, multilateral organizations, foreign government agencies from industrialized countries, and other sources.

There is an interesting difference between non-profit NGOs whose operations expenses are primarily donor-funded versus self-sufficient. Those domestic NGOs who are primarily funded through foreign “guests” may have new(er) technocratic requirements of accountability and effectiveness that require that they put their constituents under surveillance and implement new management practices that change their organizational structure and direct resources away from their humanitarian mission (Hearn 1998; Harsh, Mbatia, and Shrum 2010). Unfortunately, this accountability is mandated upwards to their funders, but not downwards to their constituents; similarly, the effectiveness is often measured in reductionist terms that devalue the social impact of the provided service, which is harder to measure.

Alternatively, NGOs who are economically self-sufficient in their operations expenses (perhaps by charging the constituents to whom they provide services<sup>4</sup>) might be assumed to be accountable and effective, instead of corrupt, because of being embedded in the market. This assumption is incorrect, as such self-sufficient NGOs have minimal requirements of upwards accountability and little to no requirements of downwards accountability beyond consumer satisfaction.<sup>5</sup> An advantage held by such self-sufficient non-governmental organizations is that they also have little to no surveillance requirements, and with the resiliency of a broader economic base and more control over their organization, they can continue to complete their humanitarian mission (Mitlin, Hickey, and Bebbington 2007). Such organizations are, essentially, run as businesses and must worry about advertising, solicitation, and consumer satisfaction in order to continue operating according to economies of scale; this is both a problem and an opportunity. NGOs worrying about consumer satisfaction have an opportunity to respond to their constituents

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<sup>4</sup> As an alternative to autonomy through charging their constituents a nominal fee to pay for operations expenses, these NGOs might pay their operations expenses through a substantial endowment or a steady level of private donations. In fact, Harsh, Mbatia, and Shrum (2010) also briefly note a difference between the deployment of resources (used for accountability versus efficiency) between two church-based NGOs, with private donations that they directly controlled as income versus project-based donations that necessarily entailed reporting and upwards accountability to “guests.”

<sup>5</sup> There is plenty of critical scholarship describing NGOs as instruments of hegemonic neoliberalism in international development. To add nuance to this discussion, this research examines large domestic NGOs who are fulfilling their humanitarian mission using economies of scale without many of the practices of surveillance that are common to NGOs in developing countries.



with, at minimum, a limited form of downwards accountability. They also have the opportunity to redefine typical marketing strategies, requiring surveillance into more benign social marketing and/or communication for the purpose of social improvement.

Running an NGO as a social enterprise similar to a business might be problematic if they choose to accept funding from new “guests” in the field of international development, that is, foreign venture capitalists or foreign bank loan officers, in order to expand the services they provide. In such a case, they will have exchanged the tied funding of bilateral development aid for a different instrument of neoliberal capitalism. It is possible that by becoming further enmeshed with the private industrial sector, they may potentially make large-scale gains in their missions. However, it is also possible that they will be misdirected by the spirit of capitalism and its pursuit of capital accumulation (Weber 2003) to the neglect of their humanitarian ideals.

#### **4. Avoidable Blindness and Three Models of Technoscientific Development**

Presently, there are 39 million people who are blind in ways that are potentially correctable—out of a total of 48 million blind persons worldwide. Avoidable blindness is the term utilized by the World Health Organization to describe these individuals of whom 90% reside in countries that are less economically developed, also known as LEDCs.

Cataract disease, or opacification of the natural lens, is prevalent in both LEDCs and in the wealthy, industrialized countries of the West; they cause almost 50% of the blindness in the world. Cataracts are not well understood; the disease etiology has been correlated with many risk factors to include vitamin A deficiency, smoking, UV light exposure, lead exposure, and other factors. The most important risk factor, however, is age. Individuals age 50 and older are more likely to develop cataracts. In the United States, 20% of adults over the age of 65 have vision loss related to cataract disease (Anonymous 2009). Gender is another risk factor for cataract; women are twice as likely to be blind as compared to men (Abou-Gareeb *et al.* 2001). Women are also twice as likely to have cataracts as compared to men (Lewallen and Courtright 2002).

Scarce (or nonexistent) eye care services in LEDCs means there is often a time delay between the onset of the cataract and the removal of the opacified lens. This time delay makes white cataracts more prevalent in ophthalmology clinics and surgical theaters in LEDCs (Chakrabarti and Singh 2000). These cataracts are more advanced and thus more difficult to remove (Chakrabarti and Sing 2000).

There is a contrast between three models that are currently being used by development NGOs addressing avoidable blindness due to cataract (and other diseases): (1) a developmentalist model of high-technology transfer of the type that the appropriate technology movement would critique; (2) a contextually appropriate model of low-technology transfer of the type that the appropriate technology movement would approve; (3) my proposed concept for what is occurring in South Asia, the *contextually appropriate local production of high technology*, representing a new shift in the appropriate technology movement.

#### 4.1 Model I. Developmentalist High-Technology Transfer

In the developmentalist model of high technology transfer, the solution that is often proposed and implemented by many well-intentioned Western ophthalmologists to address blindness due to cataract in LEDCs is the donation of expensive ultrasound phacoemulsification machines, which break and cannot be repaired. For example, at the Unite for Sight Global Health & Innovation Conference at Yale University in April 2011, a Caucasian-American male (with a U.S. accent)<sup>6</sup> in a panel audience questioned the utility of donating expensive ultrasound phacoemulsification machines, used for cataract surgery, as a practical way of assisting the efforts to mitigate avoidable blindness in less economically developed countries. His question to the panelists and the remaining audience members was in effect, What should we do instead? What can I do?

He is right to question the utility of this model of high technology transfer. It involves conceptualizing the complex problem of avoidable blindness due to cataract disease in terms of a simple “lack” of an artifact—the high-tech surgical instrument. Such a model of high-technology transfer does not typically result in local capacity being built, as once the machine breaks there are typically no local biomedical technicians available to make repairs; therefore, the “host” clinic is in much the same state as it started.<sup>7</sup>

Similarly, another solution suggested by well-intentioned ophthalmologists from industrialized countries, or from the high-income urban cities within

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<sup>6</sup> He self-identified as an ophthalmologist but did not provide his nationality or name. He did indicate that he had a thriving private clinic and wanted to “give back” but found that the expensive equipment that he had previously donated to an eye clinic in a less economically developed country quickly broke and was no longer being used.

<sup>7</sup> For a review by Duke University biomedical engineering professor Robert Malkin about the technical problems that plague hospitals and clinics in developing countries, please see his 2007 article. He is the founder of an organization called Engineering World Health, whose goal is to use U.S. engineering students to train biomedical instrument technicians in less economically developed countries.

LEDCs, involves temporary surgical camps performed by volunteers. As an example, a Nepalese newspaper reports that 50 surgeries were performed in 10 days by a team of eight U.S. Army Medical Officers for cataract and other diseases (*Himalayan Times* 2009). Though kindly meant, this solution conceptualizes the complex problem of avoidable blindness due to cataract disease in terms of a simple “lack” of experts. Unfortunately, the short-term time donation of the expertise of Western ophthalmologists does not allow for follow-up services,<sup>8</sup> for example, checking 1-month and 6-month visual outcomes, or the treatment of post-surgical complications.

As another example, an organization called Orbis International started in 1982 with a commercial airline plane that was retrofitted to become a “flying eye hospital” to give sight to patients around the globe (Orbis n.d.). However, it was criticized by British ophthalmologist Dr. Allen Foster, because its training program was not contextually appropriate (Gray 1992). As sociologist Robert Gray explains, “Foster characterized the program as showing [ophthalmologists in less economically developed countries] a Mercedes-Benz when resources would better be spent on hundreds of bicycles” (1992).<sup>9</sup> Orbis has since broadened its scope of work. For example, in Bangladesh, Orbis works with government-run hospitals to support pediatric ophthalmology residents and fellows to develop and strengthen that ophthalmology specialty in the country.<sup>10</sup>

In general, despite small gains, the developmentalist model is a failure because there is no long-term capacity or infrastructure being built, and the

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<sup>8</sup> Iowa State University mechanical engineering professor Mark Bryden calls development programs with good intentions and short attention spans “drive-by” development (2011). As the founder of Unite for Sight, Jennifer Staple Clark, argued passionately in her presentation “Innovation & Outcomes: Understanding and Maximizing Real Impact” on April 15, 2011, at the Global Health and Innovation conference at Yale University, saying that sometimes doing nothing is better than doing anything. Such drive-by development programs may engender suspicion against development professionals by communities who have been hurt repeatedly by various NGOs and their failed development projects and lack of accountability (Bryden 2011).

<sup>9</sup> Foster’s words are probably grounded in his own experiences as an epidemiologist, community ophthalmologist and “guest” working in the African continent (Kenya and ten years in Tanzania) and in South Asia (India and Bangladesh; see London School of Hygiene and Tropical Medicine 2012). However, his words are somewhat dismissive of the capabilities of people in less economically developed countries to build such a “Mercedes-Benz,” or at least a contextually appropriate Tata Nano (Brown 2012; see Reddy’s 1973 critique of the appropriate technology movement, which I have discussed earlier in this paper). However, he must have changed his mind because in his publication titled “Appropriate Technology,” he, along with other Western ophthalmologists, argues in support of using intraocular lenses instead of aphasic cokebottle eyeglasses as the standard cataract surgery in LEDCs (not just in ICs; see Wormald *et al.* 1998).

<sup>10</sup> I learned this through interviews and informal conversation with several ophthalmologists and other community ophthalmology professionals from Bangladesh and Nepal.

needs of patients with avoidable blindness are addressed temporarily and hazily. This model of high technology transfer would have been heavily critiqued by members of the Appropriate Technology movement started by Schumacher and others in the 1960s.

#### 4.2 *Model II. Contextually Appropriate Low-Technology Transfer*

The model of contextually appropriate low technology transfer is exemplified by the non-profit organization Unite for Sight based in New Haven, Connecticut. Unite for Sight advocates the use of Western donations of money and eyeglasses to provide free services for low-income people in LEDCs. This model offered by Unite for Sight falls more in line with the appropriate technology movement's focus on intermediate technology transfer. As an organization, Unite for Sight is cognizant of the importance of building local capacity. In order to do this, it has broadened the stated problem of treating blindness due to cataract disease from a simple "lack" of modern instruments or experts to address more of the complexities of care, in particular context-specific barriers. Community ophthalmology professionals have identified context-specific barriers including: (1) culturally specific barriers (e.g., if women need chaperones to travel, or if old people expect certain levels of respect from young medical care providers); (2) opportunity costs (the family resources lost when an able-bodied family member misses work to take a blind family member to the hospital); (3) travel costs; and (4) other similar barriers (Williams 2008). In describing the activities of Unite for Sight, the ophthalmologists and organizers involved emphasize that each outreach eye camp<sup>11</sup> starts with eye health education. Instead of flying in Western experts to temporarily provide eye health care services, Unite for Sight creates long-term partnerships with private (for-profit and non-profit) local clinics in order to build local capacity by providing them with a steady stream of patients. This model depends primarily on the social entrepreneurial skills of U.S. university and medical students—who may or may not have a long-term interest in global public health—in order to both collect eyeglasses and raise funds for treating patients at local clinics in LEDCs. Also, it is primarily focused on educating and treating patients, instead of infrastructure creation; therefore, it provides limited support for training local personnel in LEDCs.

At the for-profit Crystal Eye Clinic in Ghana, the co-owner, ophthalmologist Dr. James A. Clarke,<sup>12</sup> has to pay import duties on the donated eyeglasses

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<sup>11</sup> An outreach eye camp minimally involves travelling to a rural community (which typically does not have primary eye care facilities) and screening patients for eye diseases.

<sup>12</sup> His wife, a general medical physician, is the second co-owner.

brought by Unite for Sight volunteers when they visit as “guests” (2011).<sup>13</sup> However, he continues as a “host” for Unite for Sight so that he can continue his philanthropic work with low-income patients in rural areas of Ghana. As part of their efforts to build up local capacity, Unite for Sight pays for supplies not labor; this represents about 50% of Dr. Clarke’s costs for treating rural Ghanaian patients. The U.S. volunteers who participate as “guests” may choose to help with eye health education or even conduct small research projects for a minimum of 7 days up to 10 weeks or more.<sup>14</sup> Dr. Clarke is able to make up some of the cost of the import duties by selling these donated eyeglasses to his rural patients.

Despite its successful increases of eye health exams and cataract surgical rates in India, Ghana, and Honduras, I would argue that the Unite for Sight model of contextually appropriate low-technology transfer incrementally increases human infrastructure and maintains the status quo in terms of physical infrastructure. While it was not discussed in our interview, I am curious about the accountability demands of Crystal Eye Clinic’s relationship with Unite for Sight. Do the additional labor costs that it absorbs to provide medical care to low-income rural Ghanaians (as part of its philanthropic ideology) also include labor costs for reporting to its “guest,” Unite for Sight? Does Crystal Eye Clinic also absorb the costs of finding and/or maintaining accommodations for the physical guests (the U.S. students) that it hosts from Unite for Sight? If so, how do these additional labor costs affect the ability of Crystal Eye Clinic to effectively treat the backlog of patients that have cataract in Ghana?

#### 4.3 *Model III. Contextually Appropriate Local Production of High Technology*

The third model to address avoidable blindness is what I am theorizing as *contextually appropriate local production of high technology*. Based on my empirical research, I suggest that this third model pursues *socially responsible innovation* that includes the following components: scientific innovation, technological innovation, organizational innovation, local ideology, and a social mission. Two South Asian NGOS—Tilganga Institute of Ophthalmology (Nepal) and Aravind Eye Care Systems (India)—are non-profit social enterprises and part of the scientific field of ophthalmology. They are addressing “undone science” for the *doubly orphaned diseases* of avoidable blindness and creating the requisite hospital and personnel infrastructure by the combination of compassionate ideology and a social mission to “reach the unreached”;

<sup>13</sup> I learned this through an interview with Dr. James A. Clarke in April 2011.

<sup>14</sup> I learned this through regular emails sent by the Unite for Sight listserv in 2010-2013 describing the opportunities for global health volunteer experience.

an intraocular lens manufacturing facility (technological innovation); new surgical techniques (scientific innovation); and a unique cost recovery model (organizational innovation). The creation (or appropriation<sup>15</sup>) of surgical techniques, ophthalmic products, communications practices, and operations management science by these NGOs was necessary in order for their model(s) of social entrepreneurship to be effective. Also important was the local context of South Asia, where these NGOs are embedded in reminders of the discourse of Buddhist “enoughness” and the Indian independence movement, which so inspired Schumacher.

This contextually appropriate local production of high technology is a new shift in the appropriate technology movement; as they pursue *socially responsible innovation*, these organizations are performing “civil society research” appropriate to the local context and simultaneously building local infrastructure. It seems fitting, considering the origins of these NGOs in South Asia, that SRI (the acronym for *socially responsible innovation*), is another name for the Hindu goddess of wealth.

## 5. Socially Responsible Innovation to Address Avoidable Blindness

### 5.1 *The Local Context of Socially Responsible Innovation: IAPB and South Asia*

The “lack” of medical personnel and infrastructure to address avoidable blindness globally was first identified as a problem by the International Agency for the Prevention of Blindness. The IAPB was formed by premiere ophthalmologists from developing and industrialized nations in 1975; three years later it held its first general assembly in the UK. One of the founders of the IAPB,<sup>16</sup> an African-American ophthalmologist named Patricia E. Bath, also wrote the rationale for a community ophthalmology program based on her work with historically black communities in New York City and Los Angeles (Bath 1979).<sup>17</sup>

<sup>15</sup> By appropriation, I am referring to the concept developed by Eglash (2004).

<sup>16</sup> Dr. Patricia E. Bath is listed under Group F (as an alternate for Dr. W. J. Holmes) as one of the Members of the Executive Board. The executive board was elected for the IAPB on Saturday, July 8, 1978, at the General Assembly in Oxford. Dr. Holmes was elected the Executive Vice President at the time, and Sir John Wilson was elected the President. There were 170 representatives from 44 nations present (Bath 2011).

<sup>17</sup> In an interview, Dr. Bath recalls that she first presented this work “in 1976 at the American Public Health Association, where everyone looked, wondering, ‘Why is an ophthalmologist talking about public health issues?’” (Bath and Higgenbotham 2011).

In 1999, The IAPB and the World Health Organization (WHO) started the Vision 2020: The Right to Sight program in the effort to control avoidable causes of blindness by 2020. Despite this effort, the problem can be said to be increasing in terms of physical numbers. There has been some success with decreasing specific disease incidence in particular regions worldwide, for example, trachoma in Africa and Asia; cataract in South Asia.

Part of the reason why the numbers of those who are blind due to avoidable causes continue to increase may be that, even with bilateral assistance from other governments or the WHO, national governments do not prioritize their limited resources for public health when they are struggling with crushing debt and, perhaps, internal corruption or other instability. Nepal is the newest federal republic in South Asia and is marked by political corruption and instability; it has had an interim government since the Maoist cease-fire in 2007. The Maoists, who fought in the 10-year civil war, were able to come to power based on the disillusionment of the disenfranchised rural and poor people of Nepal because the monarchy was ignoring their needs. Nepal is ranked as one of the poorest nations in the world (210 out of 229 countries), with a GDP per capita of \$1200 (2009 USD) and 31% of its population living below the poverty line. The United States government has given more than \$1 billion in aid to Nepal since 1951.

India has the advantage of a more stable government since the assassinations of government leaders stopped in the late 1990s and it has been constituted since 1947. However, despite its claim to fame as the source of IIT-ians and a growing middle class, India, similar to Nepal, has 25% of its population living below the poverty line, with a GDP per capita of \$2800 (2009 USD, PPP).

Despite the challenges to economic development within each country, India and Nepal have successfully increased their cataract surgical rates, a measurement of surgeries performed per million people, since the 1980s. Unfortunately, the backlog of people waiting for cataract surgery continues to grow as the population worldwide ages.

With neoclassical economic policies advocated by the World Bank and the International Monetary Fund predominantly influencing the withdrawal of government public health services, some non-profit NGOs have turned towards entrepreneurship and innovation, instead of donations alone, in order to provide such essential services. This is demonstrated by my exemplar cases in South Asia:<sup>18</sup> the Tilganga Institute of Ophthalmology (TIO) in Nepal, and the

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<sup>18</sup> In this particular research project, I investigated four eye hospitals functioning as non-governmental organizations and social enterprises, one each in India, Nepal, Kenya, and Mexico (where the Mexican eye hospital was the only for-profit institution among them). This paper only discusses findings from the South Asian eye hospitals.

multiple hospital Aravind Eye Care System in Tamil Nadu (a state in southern India).

### 5.2 *Underlying Ideological Orientation of Socially Responsible Innovation in South Asia*

The two community ophthalmology NGOs in India and Nepal share an alternative understanding of what it means to be rational at a large scale that is inflected with local South Asian philosophies and a compassionate mission.

In 1973, the government of India awarded one of its most prominent ophthalmologists, Dr. Govindappa Venkataswamy, the Padma Sri award, recognizing his years of work as a government medical physician, medical college dean, and pioneer in rural ophthalmology (Mehta and Shenoy 2011:67). A year later, Dr. Venkataswamy went to the McDonalds' Hamburger University in Oak Brook, Illinois,; when he returned, he founded Aravind Eye Care Systems.

In 1993, sociologist George Ritzer published the McDonaldization thesis about the 'inexorable' global expansion of rationalization.<sup>19</sup> He suggested that, instead of Weber's "iron cage of rationalism" being tied to the bureaucracy, the American (meaning the U.S.) "fast-food restaurant has combined the principles of the bureaucracy with those of other rationalized precursors (for example, the assembly line, scientific management) to create a particularly powerful model of the rationalization process" (Ritzer 1996:292). The following excerpt from Rubin's article (2001) about Dr. Venkataswamy, shows the impact that his time at McDonald's Hamburger University had on his thinking about how to scale-up eye health care services in India:

"In America, there are powerful marketing devices to sell products like Coca-Cola and hamburgers," he says. "All I want to sell is good eyesight, and there are millions of people who need it." The idea for Aravind was born from that vision of McDonald's.

"If Coca-Cola can sell billions of sodas and McDonald's can sell billions of burgers," asks Dr. Venkataswamy, "why can't Aravind sell millions of sight-restoring operations, and eventually, the belief in human perfection? With sight, people could be freed from hunger, fear, and poverty. You could perfect the body, then perfect the mind and the soul, and raise people's level of thinking and acting." (Rubin 2001 quoting Dr. Govindappa Venkataswamy)

As shown in the above excerpt, Dr. Venkataswamy is very interested in the large number, "billions," that the multinational companies, The Coca-Cola

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<sup>19</sup> I have put inexorable in single quotation marks here because this case does not exemplify an adoption of rationalization processes, but rather a combination of Western rationalization processes and South Asian philosophies.



Company, Inc, and McDonald's Corporation, are capable of selling.<sup>20</sup> However, McDonald's was not the only influence on Dr. Venkataswamy as he worked to perfect humanity and raise human consciousness. Dr. Venkataswamy was heavily influenced by Aurobindo's spiritualist Integral Yoga (Vaidya 2008), which combines elements of Hinduism, Buddhism, Christianity, and Judaism. He speaks of Gandhi being an influence on his medical practice (Venkataswamy 1992). Since Dr. Venkataswamy was growing up during the latter part of the Indian independence movement (Venkataswamy 1992), it was likely that he was also influenced by the Hindu secular philosophies of *swaraj* (self-rule), *swadeshi* (self-sufficiency), as well as the related Gandhian philosophies of local production of technoscience (Ninan 2009) and decentralization of political power (Ojha 2013).

Dr. Venkataswamy is credited with the innovative cost recovery system used by both Aravind and Tilganga to provide high quality cataract surgery to a high volume of South Asian patients with a deeply subsidized or free price (see the subsection on Organizational Innovations below). The historical contingencies of the development of this cost recovery system are explained elsewhere (Mehta and Shenoy 2011; Williams 2013). David Green, a U.S. entrepreneur and co-founder (with Dr. V and others) of SEVA Foundation (California), describes the work of Aravind Eye Care Systems to provide high quality surgery to anyone who needs it as "compassionate capitalism" (Oregon Public Broadcasting 2005).

### 5.3 *Technological Innovation in Socially Responsible Innovation: Producing the IOL Locally*

Aravind and Tilganga realized that the high technology considered "appropriate" for the Western world was also appropriate for the developing world in terms of best post-surgical outcomes for the patients.

By the late 1980s, Western ophthalmologists were performing phacoemulsification and inserting hard poly-methyl-methacrylate intraocular lenses as a standard practice to correct blindness due to cataract disease. At this same time, ophthalmologists in LEDCs were performing intracapsular cataract extraction and providing aphasic "coke-bottle" eyeglasses. These eyeglasses

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<sup>20</sup> In general, multinational companies are not known for their social missions. The fact that Dr. V looked to them as an example of good practices, considering his social mission, is quite disconcerting at first consideration. However, I argue (based on Rubin's article; see Rubin 2001) that he was predominantly interested in the repeatability and efficiency of their practices at a large scale. He admired the fact that these large organizations were able to reach so many people with their products. Considering the size of the problem of avoidable blindness, I argue that he was keen to implement such management practices in his eye hospital.

were the standard in the developing world for post-cataract removal vision correction; however, they did not allow for peripheral vision and were easily misplaced or broken (Mahadevan 2007; Tielsch 1998; Wormald, Evans, and Foster 1998). Intraocular lenses were known to provide better post-surgical vision outcomes than aphasic eyeglasses.

Intraocular lenses, however, were expensive, at 150-200 US Dollars each. At first ophthalmologists in South Asia relied on intraocular lenses donated by their Western colleagues in the U.S. and Australia. Meanwhile, they identified the necessity of reducing the cost of intraocular lenses so that their insertion after natural lens removal could become the global standard, instead of the standard for wealthy patients only. In order to reduce the cost, they planned to manufacture the lenses locally. However, they first had to challenge assumptions, held by domestic and foreign peers, about the capability of less economically developed countries to produce high technology.

Dr. Sanduk Ruit, a civil servant in Nepal, proposed that Nepal manufacture intraocular lenses. Although a campaign was waged against him by his superior in the ophthalmology department of the hospital where he worked (Mahadevan 2007), Ruit and sympathetic colleagues founded the Nepal Eye Program in 1992. Tilganga Institute of Ophthalmology became the operating body of the Nepal Eye Program in 1994. Also, Ruit and his colleagues founded The Fred Hollows Foundation Intraocular Lens Laboratory, with assistance from The Fred Hollows Foundation of Australia and other donors. The Fred Hollows Foundation Intraocular Lens Laboratory produces high quality intraocular lenses certified by the European Union. Additionally, The Fred Hollows Foundation Intraocular Lens Laboratory provides 100% of lenses used in Nepal and sells lenses in Africa, Asia, and, as of March 2011, in Australia. Similarly, the Aurolab, which is a unit of Aravind, sells 7% of the world's market for intraocular lenses. Aurolab was started with the help of U.S. social entrepreneur David Green and the SEVA Foundation (U.S.) in 1992. The least expensive lenses produced by FHFIOI and Aurolab cost about \$5-7.

#### 5.4 *Scientific Innovation in Socially Responsible Innovation: Reinventing Surgical Techniques*

Having access to a low-cost supply of high quality lenses—and also access to training services to learn the extracapsular cataract extraction surgical technique necessary for implanting IOLs—meant that ophthalmologists in South Asia could offer this appropriate high technology to their patients. However, the technology alone was insufficient to address the cataract surgery backlog. Additionally, ophthalmologists at Aravind and Tilganga adapted the high-cost

phacoemulsification technique and reinvented the small incision cataract surgery technique. This process of appropriating surgical techniques from the West was rooted in the local context of the high incidence of advanced-stage mature white cataracts among low-income patients in South Asia. However, the purpose of these ophthalmologists in South Asia was both to help low-income patients and also to make additions to global modern science. I have described such appropriation, being rooted locally with a more global purpose, as “cosmopolitan appropriation” in my previous work (Williams 2011).

### 5.5 *Organizational Innovation in Socially Responsible Innovation: New Finance and Management Practices*

Aravind and Tilganga are well known for their similar models of high volume cataract surgery with cost recovery. This cost recovery model required the reinterpretation and adaptation of surgical techniques, as well as the reinvention of ophthalmic products and hospital management practices by South Asian NGOs.

The cost recovery model was invented in South Asia; it uses several revenue streams to recover the costs of providing free or subsidized) surgery to low-income patients. The cost recovery model utilized by both the Tilganga Institute of Ophthalmology in Kathmandu (central) Nepal and Aravind Eye Care Systems in (southern) India, to treat avoidable blindness, is attributed to Indian ophthalmologist Dr. Govindappa Venkataswamy. Until his death in 2006, Dr. Venkataswamy worked with Indian and foreign colleagues to create the highly acclaimed Aravind Eye Care System and Aurolab in Madurai, India. Aravind provides free or subsidized eye care services without requiring proof of poverty (Rubin 2007). Their cost recovery model includes a sliding-scale fee payment schedule. At Aravind, 60% are subsidized or provided with free services; similarly at Tilganga, 33% are subsidized or free patients. This model requires access to several alternative revenue streams (donations of equipment, donations of surgery, sale of surgery, sale of ophthalmic products, sale of educational training, etc). At Tilganga the deputy medical director, Dr. Reeta Gurung, is also an ophthalmologist who specializes in the cornea; she helps to explain how such a cost recovery model works:

[F]or the salary we used to get some money from big NGOs like [Fred] Hollows [Foundation], but soon after, once we started having outpatients, we brought it down, and nullified it, so that we didn't get any money for the salary for the staff from somewhere else, we generated the money inside by selling the services. For the day to day running of the center everything is managed by the money we generate here . . . But um, just for the, like we say, we have to buy a big 40,000 US dollar microscope then we have to look

for the dollars. Having said that, all the money for the community eye centers we run in the districts, the small setups, these are supported by many other different organizations monetarily. But for Tilganga here, we support ourselves for the daily expenses and everything, for salaries and everything. (Gurung 2009)

The intraocular lens manufacturing facilities are a significant alternative revenue stream for both Aravind and Tilganga. Aurolab's revenues are reinvested into the Aravind Eye Care System (Rubin 2007). Another alternative revenue stream consists of the fees from the training programs, at Aravind and Tilganga, for eye health care professionals that are local to South Asia or foreign. At Aravind, foreign eye health care professionals come from predominantly Africa and Asia to learn surgical techniques, hospital management practices, outreach camp coordination practices, or technology repair and maintenance. A third revenue stream comes from the cost recovery model. Patients with higher incomes pay between \$200-300 per surgery at Aravind (Chang 2005a, 2005b) and approximately \$80 at Tilganga (Mahadevan 2007). The actual cost runs as low as \$15 per surgery (Chang 2005a, 2005b). For the high-income patients, Aravind offers several configurations of surgery type (phacoemulsification or small incision cataract surgery) and intraocular lens type (hard plastic poly-methyl-methacrylate or soft foldable silicone) (Prahald 2005).

What David Green calls "compassionate capitalism" (Oregon Public Broadcasting 2005) requires a high volume of patients to be effective; this was achieved by reinterpreting Fordism and Taylorism for the eye hospital. My observations at Tilganga revealed a process of care that was very slow for the patient but quite efficient, with good surgical outcomes overall. Patients come to the hospital early in the morning to wait in line all day before having surgery. This allowed individual surgeons to complete 30-80 surgeries per day. In the surgical theater, the patients were handled in the manner of an "assembly line"; they were placed in various waiting rooms that became successively smaller in size. Patients progressed through various ophthalmic technicians as they were prepped for the procedure. Some patients appeared to wear anxious expressions while waiting in silence, unknowingly surrounded by other blind patients. In the operation theater, several surgeons and patients were present at multiple tables, increasing the patient flow to the surgeons, a technique that Tilganga learned from Aravind.

Typically at Aravind, the surgeon sits on a swivel chair between two operation tables with their respective microscope setups and recently autoclaved instrument sets. The Aravind surgeons spend the morning switching back and forth between patients on tables approximately every 5 minutes. At Aravind, they have also changed the management of sources of infection in the surgical ward that makes it more efficient, but changes it significantly from

what is standard in Western industrialized nations such as the U.S. As ophthalmologist and chairman of Aravind Eye Care Systems in 2012, Ravilla D. Ravindran explains in his 2009 co-authored article:

The use of high-speed short-cycle steam sterilization and continuous reuse of I/A tubing and irrigating solutions have enabled us to perform high-volume, efficient, and cost-effective cataract surgery with an endophthalmitis rate of 0.09%, which is comparable to that reported in developed countries. [U.S.] Medicare data from the 8-year 1994 to 2001 period showed a 0.21% incidence of postoperative endophthalmitis. (Ravindran *et al.* 2009)

Thus, in addition to multiple patients per operation theater, another organizational and scientific innovation implemented by Aravind is a new protocol for sterilization that eliminates previous practices standardized in the West, but contributes towards a process of care where there is a much higher patient volume, much cheaper surgeries, and comparable postoperative infection rates.

#### 5.6 *Advantages and Disadvantages of Pursuing Socially Responsible Innovation*

In this paper, these community ophthalmology NGOs' pursuit of socially responsible innovation provides wealth that is bound by "enoughness" (Schumacher 1973). At the individual level, these community ophthalmology NGOs provide patients with freedom from debilitating blindness, from being a burden to family members, and from being unable to pursue normal activities of subsistence agriculture or other work. At the regional level, these community ophthalmology NGOs provide many jobs for a population-dense South Asia. At the national level, they provide prestige to their respective countries for their world-renowned organizational and scientific innovations, and their sophisticated high-technology laboratories. These innovations extend beyond what I have described above; they include the local production of low-cost microscopes, lasers and other high-tech instruments, and orphan drugs for glaucoma and other diseases of avoidable blindness (Williams 2013). Their innovations also include the investigation of new processes to deliver eye health care services remotely through telemedicine and partnerships with general medical practitioners (Williams 2013).

However, there are disadvantages to these community ophthalmology NGOs' pursuit of socially responsible innovation. At Aravind, the salaries for the professionals and laborers producing socially responsible innovation are deliberately kept lower than what they would make performing similar work at for-profit corporations in India. This is strategic on the part of Aravind as part

of keeping overall costs per surgery low. However, this may not be a good strategy long term, as the training that these organizations have invested in their professionals and laborers will leave with the employees if they choose to pursue better salaries elsewhere. In contrast as of 2012, Tilganga pays market-rate salaries to its laboratory technicians in Nepal, but its costs to produce the intraocular lenses exceed the income generated by lens sales. Thus, the multiple revenue stream at Tilganga is more dependent upon high-income patients and donations than at Aravind.

The main disadvantage of the community ophthalmology NGOs' pursuit of Socially Responsible Innovation is tied to their advantage of economic independence. These community ophthalmology NGOs function as charitable organizations and run themselves as businesses. Thus, they must balance the conflicting demands of capital accumulation and a social mission. While they have performed this balancing act admirably thus far, I did not find any institutional mechanisms in place to ensure that this balance will continue into the future.<sup>21</sup> Meanwhile, their interests in expanding their capacity to care compassionately for rural, low-income patients means they are seeking out alternative sources of funding, including loans and venture capital, without being reflexive about how pressures from such funding sources may change their organizations.

## 6. Conclusion

In this paper we learn that undone science (Hess 2007) might be considered as part of a spectrum of undone innovation that also includes undone technology (Woodhouse personal communication) and undone management practices. An analysis of undone science sheds light on issues of uneven development of research-agendas (Hess 2007; Frickel *et al.* 2010). Similarly, might an analysis of undone technology shed light on how industrial manufacturers imagine the potential users and non-users or excluded users of their products within projected future societies? In contrast, an analysis of undone management practices may shed light on the uneven implementation of logistics and operations practices as shaped by social and political pressures of the pursuit of capital accumulation versus social justice.<sup>22</sup>

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<sup>21</sup> In contrast to the senior leadership, some of the newer professionals working at Aravind rarely or never interacted with the esteemed Dr. V. Considering that he passed 7 years ago, they are not quite sure what his philosophy represents besides providing compassionate care at low cost. Tilganga has not officially defined their mission.

<sup>22</sup> Ritzer's McDonaldization thesis criticizes processes of rationalization. While I agree that these processes configure people and society in particular ways, and often in negative ways, I am

This research describing NGOs that conduct socially responsible innovation allows us to understand that the developmentalist model of international development is not adequate to build local human and physical infrastructure. The developmentalist model typically focuses on the “lack” of modern science, high-tech instruments, and experts within less economically developed countries and tries to address this gap. However, such a simplistic problem definition is unlikely to result in the creation of local human and physical infrastructure within LEDCs. From the 1960s onwards, the appropriate technology movement demonstrated to international development professionals the importance of local context when introducing new science and technology. Presently, this newer shift in the appropriate technology movement demonstrates the importance of understanding the multifaceted nature of undone innovation and the necessity of interlocking innovations to address them.

Socially responsible innovation addresses this spectrum of undone innovation with a variety of interlocking innovations and an underlying ideology and social mission. In this paper, the South Asian NGOs started first with a social mission of bringing high quality surgery to the rural disenfranchised poor blind people of India and Nepal. They produced low-cost intraocular lenses locally in South Asia, and this together with low cost surgical techniques, also reinvented locally, significantly lowered the cost of high quality cataract surgery per person. They used innovations in management practices to facilitate a high volume of patients and to further cut costs. These new management practices changed how potential sources of infections are managed in the surgical theater, while continuing to prioritize patient safety and good clinical outcomes.

Tilganga and Aravind are attentive to multiple facets of the complex problem of a high-volume of patients with avoidable blindness due to cataract disease. In discussing the “ethical dilemmas of helping,” Gray suggests that there are conflicting value systems between public health and medicine (1992). A public health solution designed for the masses in a country with scarce resources involves the discomfort of cost-benefit analyses; this clashes with the typical medical solution—the most efficacious, expensive, and sophisticated

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also cognizant of some of the positive benefits. In particular, this paper shows how important organizational processes of movement and management (of materials and people) might be for effective deployment of development aid. When I sat in on session L1 at the 2011 Unite for Sight Global Health Innovation Conference, and listened to an executive from Pepsi Company discuss “Food Industry’s Role in Finding Solutions to Global Nutrition Challenges,” I was very much struck by a question from an audience member, as she was building upon a talking point by the executive. To paraphrase, her question was something to the effect of “If Pepsi and other multinational companies have such great logistics that their products can be found in the most out of the way places all over the world, why don’t they help distribute basic food and medicines to these places?”

science and technology—to relieve the suffering of an individual (Gray 1992). Through a mission to provide high quality low-cost eye health care for the “unreached,” Aravind and Tilganga challenge and then attempt to bridge this dichotomy between high volume and high tech in global health.

While initially they were constrained by a “lack” of infrastructure, Aravind and Tilganga have performed “civil society research” and, over time, built up substantial local infrastructure to address diseases of avoidable blindness. They are also providing high quality modern care to low-income patients of the global south at reduced or no cost. In this era of neoliberal globalization, such NGOs are demonstrating how compassionate capitalism can provide innovative technoscience and also address inequities in public health.

The pursuit of socially responsible innovation is definitely an alternative to previous models of appropriate technology and economic development. The NGOs functioning as social enterprises have more autonomy because of their economic independence; however their market embeddedness and the fact that accountability is not required have the potential to derail them from their social missions if they are not careful.

In summary, this paper has described *contextually appropriate local production of high technology* that focuses on *socially responsible innovation* for purposes of social improvement and is rooted in non-profit, social enterprise organizations to include: (1) scientific innovation; (2) organizational innovation; (3) technological innovation; and (4) an underlying ideological orientation. There is a new shift in the appropriate technology movement in less economically developed countries where self-sufficient NGOs in the scientific field of ophthalmology are addressing undone innovation for the *doubly orphaned diseases* of avoidable blindness.

## Acknowledgments

*Thanks to the discussant Charles Perrow for his comments on an earlier version of this paper at the regular Technology session of the annual meeting of the American Sociological Association in August 2012. Also thanks to the two anonymous referees for their comments and literature suggestions. The work represented in this paper was funded by the Council of American Overseas Research Centers Multi-Country Fellowship, the Rensselaer Polytechnic Institute Humanities Arts and Social Sciences Fellowship, and the National Science Foundation Doctoral Dissertation Research Improvement Grant 1153308.*



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