Chapter 1
From Innovation to Social Impact

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1.1 What Is Innovation?

Today, there appears to be a widespread call for innovation: product innovation, process innovation, market innovation, organizational innovation, and social innovation. It sometimes feels as though, when at loss, we call upon innovation. The origin of the word *innovation* means "restoration, renewal," from the Latin *innovationem* and *innovare*. Joseph Schumpeter is considered as the first economist to have drawn attention to the importance of innovation in the 1930s (Croitoru 2012; Schumpeter 1911). Innovation can be a new method, idea, or product—something that is new or different. Innovation's key characteristic is that it is assumed to provide a significant, positive change. "*To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need* […]".[1] In the context of development, we look more specifically at social innovation, which can be described as "*… a novel solution to a social problem that is more effective, efficient, sustainable, or just than current solutions. The value created accrues primarily to society rather than to private individuals*."[2]

[1] http://www.businessdictionary.com/definition/innovation.html.

[2] https://www.gsb.stanford.edu/faculty-research/centers-initiatives/csi/defining-social-innovation.

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Innovation is often divided into two broad categories: evolutionary innovation (also called continuous or dynamic evolutionary innovation) brought about by many incremental advances in technology or processes, and revolutionary innovation (also called discontinuous innovation) which is often disruptive and new.[3] In the technologies for development field, both types of innovation exist. When considering the significant needs that continue to go unmet in the Global South, frugal innovation is particularly important. Frugal innovation is a process whereby new business models are developed, value chains are reconfigured, and products are redesigned in a scalable, sustainable manner to serve users facing extreme affordability constraints: "*Simple, frugal innovation provides functional solutions using scant resources for the many who have little means*".[4] Frugal innovation implies doing better with less by focusing on affordability, simplicity, quality, and sustainability.[5]

1.2 Progress Driven by Technological Innovation

The innovation that interests us here is technological innovation for sustainable development in the Global South. Since 1990, a billion people have escaped extreme poverty, 2.1 billion have gained access to improved sanitation, and more than 2.6 billion have gained access to an improved source of drinking water (United Nations 2015). Between 1990 and 2015, the global under-five mortality rate drastically decreased from 91 per 1000 live births to 43. Between 2000 and 2015, the incidence of HIV, malaria, and tuberculosis declined. The proportion of seats held by women in parliaments worldwide, though still a far cry from egalitarian representation, rose from 17 to 23% in 2016 (UNDP 2016). Technological innovation has played an important role in this progress. New technologies can help governments and citizens to interact more efficiently and increase the scope and efficiency of public services. With the steadily growing penetration rate of mobile phones, many countries are now able to use mobile phones to extend basic social services, including health care, financial services and education, to hard-to-reach populations. The Internet allows for considerably more information sharing than any other means of communication ever has (UNDP 2016).

Technology is one of the key factors that can help developing countries close the gap with industrialized countries. In addition to infrastructure, a productive and healthy workforce, roads, and access to information and knowledge, technology can help countries to leapfrog forward (Sachs 2015; Wooldridge 2010). For instance, now that traditional sources of energy such as fossil fuels are coming to an end, adopting renewable energies based on hydro-, wind-, or solar power might offer an opportunity for developing countries to not repeat the same mistakes made by industrialized countries, but instead forge ahead with the help of cutting-edge

[3] http://www.businessdictionary.com/definition/innovation.html.

[4] http://www.frugal-innovation.com/what-is-frugal-innovation.

[5] https://hbr.org/2014/11/4-ceos-who-are-making-frugal-innovation-work.

technology in the energy and health sectors. Mobile technology can be transformative. For instance, mhealth apps can help upscale health programmes for prenatal care. It can also raise awareness about the risk of contracting malaria and smart phones can now diagnose pneumonia via diagnostic devices (Ettinger et al. 2016; Friedman and Karlen 2015). Mobile technology can also leverage social impact in the financial sector by providing remote banking services for rural low-income communities and information for farmers about fair market prices (Martin and Abbot 2011).

1.3 Remaining Challenges

However, as outlined in the 2030 Agenda for Sustainable Development, many needs are yet to be met in the Global South.[6] Human development has been uneven, as progress has bypassed many communities; others have merely managed to ensure basic human needs. Even though poverty has been reduced massively over the past 25 years, poor nutrition still causes 45% of the deaths among children under five. Stunting and other delays in physical development are still very common in children in developing countries. Yet, a third of the world's food supply is wasted each year. By reducing this figure to 25%, 870 million more people could be fed. Unless the deprivation is addressed, 167 million children will live in extreme poverty by 2030, and 69 million children under five will die of preventable causes. These outcomes will undoubtedly have a negative impact on the capacities of future generations. 114 million young people and 644 million adults still lack basic reading and writing skills. Persistent deprivation is observable in various aspects of human development. Yet, the income gap continued to widen in 34 of the 83 countries observed between 2008 and 2013. In 23 countries, the poorest 40% saw their income decline; and yet, alarmingly, income growth has been particularly pronounced at the top rungs of the income ladder—in other words, the rich get richer while the poor get poorer. Approximately 46% of the total increase in income between 1988 and 2011 was attributed to wealthiest 10% of the population. Since 2000, 50% of the increase in global wealth benefited only the wealthiest 1% of the world's population; only 1% went to the poorest 50%. Global wealth has become far more concentrated. In 2000, the wealthiest 1% of the population held 32% of global wealth. This increased to 46% in 2010 (UNDP 2016). Not surprisingly, new development challenges have emerged and/or deepened, including climate changes, conflict, and desperate migration (UNDP 2016).

[6] http://www.un.org/sustainabledevelopment/development-agenda/.

1.4 Need for Social Impact

Innovation is the new buzzword. Much hope has been placed on technological innovation, social innovation, financial innovation, and organizational innovation; we might even start hearing talk about the need to *innovate innovation*. However, innovation in itself is not enough. Social impact—meaning positive change for society and, in this case, low-income communities in the Global South—requires successful implementation and use of technologies at a large scale. Why, with rampant technological innovation, does the social impact of technology remain so limited? There are still many needs unmet in many parts of the world, and much hope is being placed on innovation to accelerate the implementation of the SDG's that aim for significant social impact. This chapter explores some of the decisive key factors when considering how we can move from innovation to social impact.

Figure 1.1 shows a thermal water heating system based on photovoltaic pipes in Ghandruk, Nepal. Initial cost of USD 400 for an average use life of 10 years. Enough hot water is provided for six hot showers for tourists per day, providing an additional sustainable opportunity for revenue creation.

Fig. 1.1 Thermal water heating system

1.5 The Bumpy Road to Social Impact

Developing successful technologies is challenging, and obtaining the desired social impact is even more so. For an innovation to have social impact, it must make the transition from an innovation to a technology that can be implemented at scale, e.g., by becoming a mainstream product such as a smart phone. The key question is how can a technology be brought to scale in order to have a broad and positive impact? Ensuring that a technological solution successfully addresses a specific issue in the Global South requires careful attention during each phase of production, from the initial idea to bringing the technology to scale (Hostettler 2015). The first step is conducting a thorough needs assessment in order to ensure that intended beneficiaries' priority needs are being targeted and that the right population has been identified. The needs assessment can also help indicate whether a technology will be socioculturally appropriate and therefore increase the chances of adoption. During prototype development in collaboration with key stakeholders, the cost of the technology—a crucial factor—must be carefully considered, as well as the customers' ability and willingness to pay for it. An unaffordable technology will not have the desired impact, as no one will be able to purchase it. Developing a sustainable business model from the outset of technological innovation is key. If economic insight is not part of the technological innovation process, then the chances of failure increase dramatically, as the long-term financial sustainability cannot be ensured.

Regarding technical aspects, especially in developing countries, a technology's robustness is crucial, as it will have to withstand high temperatures, humidity, dust, and unstable electrical circuits. Other key questions to be considered are: Is the technology easy to use, or can it only be operated by experts? In the event of a breakdown, is there a supply chain for spare parts, or will they need to be imported at a prohibitive cost from developed countries? Do the required capacities and infrastructure for repairs exist? Can the waste products of production and the technological product be recycled at the end of its life? Does the product meet the objectives of a circular economy? How can local staff be trained? Does the technology comply with national and international standards? What needs should be considered regarding the legal framework, e.g., patenting or open access? In addition, we need to ask ourselves, does this technology push local companies out of business? Does it consider local political factors such as corruption and civil unrest? Who will have access to this technology? Does it run the risk of creating inequalities?

It is particularly important to integrate scalability early on. Key factors such as country size, the political landscape, culture, language, the potential cost of establishing a regional service network, logistical challenges, spare part depots, and human resources must be taken into account. A large-scale study of 20,000 geotagged households in Kenya showed that 50% of unconnected homes are "under grid," meaning they are within range of an existing transformer but are not connected. It turned out that the need for innovation lies not at the technological level but in identifying appropriate tech adoption incentives, such as subsidies and innovative financing mechanisms (Lee et al. 2016). This experience shows the importance of taking an

interdisciplinary approach by bringing together practitioners, engineers, anthropologists, economists, computer scientists etc. to develop innovation that can bring about a large-scale, positive social impact.

The constraints of low-resource settings can be a strong driver of innovation. People living in rural or urban areas, educated or uneducated, are not just consumers of innovation, they can also be the source. They have significant inventive power to design and solve problems locally in their own sociocultural context. In Togo, for instance, a 3D-printer was made using electronic waste salvaged from landfill sites, with the aim of improving the lives of communities by "printing" objects such as medical prostheses.[7] 3D printing technology has the potential to bring about concrete social impact and is particularly interesting in emergency relief situations and for providing medical services in remote areas. Medical devices can be printed on demand and in adequate quantity, e.g., irrigation syringes, oxygen splinters, umbilical cords, and prostheses. Furthermore, using portable solar-powered 3D printers can increase the technology's autonomy. Overall, 3D printing could not only improve health care in the developing world but could also allow for economic independence. 3D printing might help countries launch their own production rather than depend on global supply chains by importing expensive medical devices from the developed world (Dotz 2015).

1.6 Conclusion

Social impact requires the successful implementation of a technology at a large scale. In this respect, developing a sustainable business model is crucial. De Jaeger et al. (2017) argue that the underlying challenge when it comes to ensuring a high impact depends on the development and successful implementation of a robust innovation/entrepreneurship ecosystem, the cooperation of all stakeholders, and sufficient resources. Innovation must also be linked to national and institutional systems, e.g., when developing medical technologies, the Ministry of health should be a key partner from the onset.

The challenge consists in considering all of these factors simultaneously; by not doing so, the entire arch of technology development could run the risk of collapse due to a single factor (e.g., financial sustainability or socio-cultural acceptability) not being adequately addressed. It is for this reason that universities have a key role to play in supporting the path to innovation and entrepreneurship education, with outcomes that impact society at large. Human-centered design is the core of development engineering that aims to scale for impact by incorporating development goals, constraints, and opportunities (Levine et al. 2016). Development engineering is based on the belief that innovative technologies have the potential to improve life in low-income communities by incorporating insight from the social sciences throughout technological innovation—from prototyping to production at scale.

[7] http://observers.france24.com/en/20161110-togolese-invent-3d-printer-waste.

We increasingly realize that engineers not only need to excel in their discipline but must also be able to work efficiently in economically, socially, and environmentally diverse contexts. To create a new generation of practitioners and social entrepreneurs, formal training at academic institutions must strive to include additional skill sets based on interdisciplinary training and design-based thinking in order to bridge the gap between innovation and social impact.

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