New-Age Technologies-Driven Social Innovation: What, How, Where, and Why?

V. Kumar*

Shaphali Gupta

Esraa Karam

July 2019

*Corresponding Author: V. Kumar (VK) is the Regents Professor, Richard and Susan Lenny Distinguished Chair, & Professor in Marketing, and Executive Director of the Center for Excellence in Brand and Customer Management, and the Director of the PhD Program in Marketing at the J. Mack Robinson College of Business, Georgia State University in Atlanta, GA. VK is also honored as the Chang Jiang Scholar at Huazhong University of Science and Technology in Wuhan, China; Fellow, Hagler Institute for Advanced Study, Texas A&M University, College Station, TX, USA; and the Senior Fellow, Indian School of Business, Hyderabad, India. Phone: 404-413-7590, Email: vk@gsu.edu.

Shaphali Gupta is the Assistant Professor in Marketing at the Management Development Institute (MDI), Gurgaon, India; and Research Fellow, Center for Excellence in Brand & Customer Management at the J. Mack Robinson College of Business, Georgia State University, Atlanta, GA. Phone: +91-124-4560294, Email: shaphali.Gupta@micamail.in

Esraa Karam is a doctoral student at the Department of Marketing, University of Strathclyde, U.K.; and Assistant Lecturer at Faculty of Commerce, Cairo University, Giza, Egypt, Email: esraa-karam@strath.ac.uk.

The authors thank the special issue editors for the opportunity to contribute to the literature. The authors thank their colleagues at their respective schools for providing valuable feedback on earlier versions. The authors thank Renu for copyediting the manuscript.

Abstract

Social innovation (SI) offers a sustainable solution to prevalent social issues/problems and is typically developed and deployed by a varied set of people from the society adopting a top-down and/or bottom-up approach. The disruption of new-age technologies (NATs) is immensely impacting the space of SIs, providing a resource-efficient solution, and bringing multiple outcome benefits. In this study, we discuss the SIs driven by new-age technologies and attempt to address a few critical questions around such SIs to better understand the construct, such as – What is SI? How are NATs playing a role in providing an innovative offering for the social good? Where does it take place in society? How can SI be deployed in society to reach out to the populace? And, Why SI is required for society? By employing the triangulation approach, we provide a comprehensive framework recognizing the different contexts under which SI takes place in society, explaining the possible outcomes and suggesting the boundary conditions. We then provide the generalized propositions on the proposed relationship in the SI framework. Further, this study identifies directions for future research and provides implications for firms, policymakers, and social entrepreneurs.

1. Introduction

Innovation can be generally understood as a newer and better way of doing things. First proposed as a departure from classical economics, innovation was identified as an essential entrepreneurial function (Schumpeter, 1942; Schumpeter, 1934). At its core, innovation primarily refers to the means by which the entrepreneur either creates new wealth-producing resources or endows existing resources with enhanced potential for creating wealth (Drucker, 1985). While manifesting in various forms (e.g., newer technologies, advanced processes, efficient business models) innovation lacks a single definition that is comprehensive, but instead has been defined from various viewpoints. For instance, the OECD defines innovation generally as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD/Eurostat, 2018) (p. 32). This is a broad definition that encompasses the mode of innovation and the novelty of the offering.

To better understand the space of innovation, we adopted the triangulation approach that includes reviewing the literature, providing evidence from the marketplace, and interviewing the stakeholders. This approach enabled us to view innovation along two criteria – the genesis of the innovation, and the leadership behind the innovation.

The genesis of the innovation pertains to how innovation is created/developed. Innovations are typically created using a top-down or bottom-up approach. In a *top-down approach*, the organization recognizes the need for a solution, identifies innovation in such a solution, and develops the innovation for the benefits of the users. That is, the senior management establishes the way forward for an innovation to be developed, sets the key goals, and engages the entire organization in reaching the said objective. Companies such as Tesla and Honda continue to develop innovative offerings through this approach. In a *bottom-up approach*, innovation emerges from the employees of the organizations, down to the lower ranks. Here, employee(s) identify an opportunity for improvement, develop the idea, and have the idea implemented at their organization. Companies such as 3M and Google are known for their bottom-up approach to innovation. While both top-down and bottom-up approaches are being pursued by firms, research has identified that a blend of the two approaches bodes well for firms (Birkinshaw, 2011).

The leadership behind the innovation pertains to who spearheads the innovation. In this regard, innovation can be spearheaded by firms, customers, and communities.

Firm-led innovations have been studied as (a) the adoption of an idea or behavior new to the adopting organization (Daft, 1978); (b) a means of changing an organization, either as a response to changes in the external environment or as a pre-emptive action to influence the environment (Damanpour, 1996); (c) a product, process or service new to the firm, as well as one new to the world or marketplace (Hobday, 2005); (d) changes involving a significant degree of novelty for the firm (Lööf and Heshmati, 2002); (e) an outcome-oriented measure such as new product success (Ayers, 1997); (f) the management and utilization of stakeholder feedback (Duncan, 1998); and (g) an outcome of seamless integration of research & development (R&D) and marketing functions (Gupta, 1986). Further, studies have also delineated innovation from innovativeness, specifying innovativeness as a measure of an organization's inclination to engage in innovative behavior (Menguc and Auh, 2006), or an innovative spirit within the firm (Marinova, 2004). More broadly, firm-led innovation can also be understood as entrepreneurship wherein successful firms are often those that initiate, manage, and lead the changes in an effort at being innovative (Morris and Paul, 1987; Miller, 1983).

In understanding *customer-led innovations*, research has highlighted the criticality of customers as an information source (Thomke and Von Hippel, 2002), in addition to the importance of various customer- and firm-related concepts such as organizational learning (Baker, 1999), entrepreneurship (Matsuno et al., 2002), market orientation (Hurley and Hult, 1998), customer orientation (Matsuo, 2006), and customer engagement (Kumar et al., 2010). Further, Kannan (2014) offers a prominent distinction between self-service and customer co-creation. Self-service is where a citizen/user contributes efforts in a setting that allows the delivery of an offering, such as a service, with minimal intervention from the providing firm (e.g., self-checkout at grocery stores, ATMs, ticketing kiosks, vending machines, etc.). Even though value is created in the self-service format, it is only for the citizen/user. Regarding customer co-creation, the resulting value from the users' inputs/efforts is extended to community members also (e.g., Quirky.com is a community-driven innovation platform that encourages, nourishes, produces, promotes, and rewards customer-generated product ideas, online forums for designers and developers of websites, apps, and mobile games).

Recent years have witnessed a surge in efforts towards producing *community-led innovations*. This trend was formalized by Von Hippel (2005) through the concept of "innovation community", which is defined as organized cooperation in the development, testing, and diffusion of user-initiated innovations. Additionally, with the increased penetration of the Internet worldwide and the established functioning of open-source communities, the development of innovations has emerged from the community at large, including from organizations in the non-governmental and non-profit sectors. Research has also recognized innovation efforts directed towards community development as a result of the maturing of information and communication technologies (ICTs). Collectively, this area of study and practice is referred to as community informatics (Lee et al., 2003; Williams and Durrance, 2008), and pertains to the design and management of information systems and infrastructures by civic and municipal entities (Carroll and Rosson, 2007).

Among the innovation classification listed in Table 1, firms have adopted various forms of innovation such as feedback (Hall and Vredenburg, 2003; Hart and Sharma, 2004), R&D activities (Gupta, 1986; Crépon, 1998), frugal innovation (Cappelli et al., 2010; Petrick and Juntiwasarakij, 2011), reverse innovation (Govindarajan and Ramamurti, 2011; Zeschky et al., 2014), grassroots innovation (Gupta, 2019; Smith et al., 2016), jugaad innovation (Radjou et al., 2012; Prabhu and Jain, 2015), customer co-creation (Sawhney et al., 2006; Mahr et al., 2014), and social innovation (Mulgan et al., 2007).

Insert Table 1 here

Following this broad overview of innovation origins, the remainder of this study will focus on social innovation (SI), a unique form of community-led innovation. Specifically, this study aims to develop a holistic view of the SI process, as identified across different research streams. In doing so, we identify the major players in the SI process and their respective roles.

In this regard, the rest of the study is structured as follows. Section 2 provides an overview of SI, as observed vis-à-vis other forms of innovations. Section 3 contains the relevant literature review on SI. Section 4 presents the marketplace evidence of how popular new-age technologies drive SIs across developing and developed markets. Section 5 briefly describes our field interview process in gathering information to develop the proposed framework. Section 6 presents the conceptual framework to understand the role of technology in SI. Section 7

discusses the societal challenges regarding technology resource constraints for the purposes of SI. Section 8 identifies managerial implications and future research directions.

2. Social Innovation

Conceptualized as an instrument for creating lasting social change, social innovation (SI) has been defined from various viewpoints. From a largely social perspective, Mulgan et al. (2007) define social innovation as innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organizations whose primary purposes are social. That is, SI has been considered to typically address social challenges through systemic solutions that are focused on the user's needs. Relatedly, user's needs have been addressed by other forms of innovation such as frugal innovation, reverse innovation, grassroots innovation, and *jugaad* innovation. While these forms of innovation share a fair degree of overlap, they also differ along some key aspects. To better aid understanding of these forms, Table 2 presents key traits along which the various types of innovations can be viewed.

Insert Table 2 here

From a process-outcome-value perspective, SI has been defined as a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals (Phills Jr et al., 2008). By recognizing the process of innovation, the invention itself, the spread of the innovation, and the value derived from an innovation, SI has been conceptualized to benefit the broader community rather than specific (or a group of) individuals.

From a stakeholder perspective, SI has been defined as seeking new answers to social problems by identifying and delivering new services that improve the quality of life of individuals and communities; and by identifying and implementing new labor market integration processes, new competencies, new jobs, and new forms of participation, as diverse elements that each contribute to improving the position of individuals in the workforce (OECD, 2010). This perspective indicates the importance accorded to all members that can derive welfare from an innovation that is geared towards local development.

Regardless of the perspective, SI can be understood as a better way forward that is available to all members of society. Popular examples of SI can be found in the fields of

microfinancing (e.g., Grameen Bank), human rights (e.g., Amnesty International), education (e.g., the open university system), environmental sustainability (e.g., emissions trading or cap and trade), and sustainable trade practices (e.g., fair trade certified products), among others. Whereas SI, in most cases, has 'green' elements to it, it has also been effectively used in the business community in growing the brand or firm or profits, through product design (e.g., Apple's iPod), user community (e.g., Linux and Wikipedia), and crowdsourcing (e.g., Amazon M-Turk), among others. In other words, SI can be driven not only by individuals rooting for a cause, but also by larger entities' carrying forward the ideas of change and betterment that have emerged elsewhere in the society (Mulgan, 2006).

3. Related Literature

During the last decade, the field of SI has attracted the rapidly growing interest of scholars and policymakers from different societal sectors involving a wide range of activities (Chambon et al., 1982; Moulaert & Nussbaumer, 2005; Rodríguez Herrera & Alvarado Ugarte, 2008; Mulgan, 2006a; Adam and Hess, 2010; Andrew & Klein, 2010; Dawson & Daniel, 2010; Howaldt & Schwarz, 2010; Godin, 2012; Edwards-Schachter et al., 2012). SI has been studied in various disciplines (Hillier et al., 2004) including management studies, public administration, organizational behavior, regional and urban development, sociology, and economic studies. Notably, the literature on SI is experiencing rapid growth primarily in terms of its conceptualization, characteristics, mechanism, research setting, success conditions, and practicality. In this section, six main SI premises (SIPs) are identified from reviewing the previous literature.

Since the late 1980s, scholars and researchers have created a plethora of definitions and conceptualizations of the concept of SI. However, there is no agreed-upon definition for SI in the social sciences literature, making the concept essentially fragmented and not yet integrated (Pol & Ville, 2009). The diversity of definitions is associated with the different disciplines and dimensions that are connected to the concept of SI, in addition to the prominent need for conceptualizing SI in a specific discipline. For instance, SI can incorporate a managerial dimension that focuses on managerial tasks and the behavior of organizations; but from a socioeconomic dimension, it focuses on innovative economic activities for social purposes.

Table 3 presents different conceptualizations of the SI concept throughout the previous literature and their various respective dimensions.

Insert Table 3 here

Indeed, various conceptualizations create a link between disciplines and different approaches in each research setting (Van der Have and Rubalcaba, 2016). Accordingly, SI might have multiple dimensions to achieve efficiency, sustainability, and effectiveness, thereby enlarging value for the society through specific managerial tasks as presented in Drucker's (1987) definition of SI. Ironically, the process of SI includes a wide range of activities and tasks that encompass different stakeholders, all of which help to identify and address pressing demands to solve challenging and complex problems. This means that SI involves various interactions between different parties and different systems, as discussed further in the sixth fundamental premise Consequently, it is essential to consider the complex dynamics included in the process of SI to guarantee positive fundamental changes to society. Therefore, the first fundamental premise for SI is:

SIP1: Social innovation is a complex, multidimensional paradigm that operates differentially based on the addressed needs.

The increased attention on the SI arena emerges mainly from its various impacts and benefits in different sectors. According to the Bureau of European Policy Adviser (BEPA) (2009), SI is viewed as an instrument that provides rapid and new solution to overcoming financial and economic crises, in addition to other global dilemmas including the scarcity of non-renewable resources, energy problems, climate change, health imbalances, and other radical environmental concerns (Edwards-Schachter et al., 2012). Consequently, SI is seen as a prominent element for the development of developing countries where new risks and inequities are threatening social cohesion (Edwards-Schachter et al., 2012; Hubert, 2010). Basically, SI has a great potential to utilize societal factors, individual creativity, community power, and environmental contexts to create novel solutions to societal and economic problems that benefit the whole society rather than only a few individuals. This will lead to improving the standard of living and quality of life for societies (Pol and Ville, 2009) as well as enhancing the welfare of nations by addressing the main societal needs and problems through innovative solutions that contribute to the social life (Van der Have and Rubalcaba, 2016). Accordingly, it can be said that SI caters to the creation of new social value to break the traditional patterns followed in the

society through creating new combinations of products and services (Defourny & Nyssens, 2010; Phillips et al., 2015); not only in the product or service offering but also in how they are implemented (Manshi, 2010; Austin et al., 2006). Examples of SI include online distant learning and charter schools that solve educational problems, socially responsible investing (SRI) for environmental sustainability and preserving human rights, and Habitat Conservation Plans (HCP) for environmental sustainability and economic development. Therefore, the second fundamental premise for the SI process is:

SIP2: Social innovation involves the creation of new social values for the purposes of communities' development and long-term societal sustainability.

One of the main factors that leverage the SI process is 'social capital'. Social capital is a means of creating new social networks and new social systems and structures in society (Benneworth and Cunha, 2015; Mieg and Töpfer, 2013). SI is empowered through the value of relationships between different stakeholders involved in the SI process. This means that investment in building and strengthening social capital is crucial to achieving the main goals and targets of the SI process. This occurs by endorsing the cross-sector partnerships and the interdisciplinary coordination among different institutions in the society to reach the main goals and objectives as well as the creation of a shared community's identities at the macro level. For instance, Unilever created an entire ecosystem in India when partnered with schools, banks, and NGOs to enhance public health awareness of handwashing, sanitation, oral health and drinking water, ultimately reaching 601 million through their educational campaigns. Therefore, the third fundamental premise for SI is:

SIP3: Social innovation primarily targets strengthening the social capital that leads to social transformation.

Importantly, SI is driven by a number of current trends including engagement of citizens and organizations in innovation, criticism of dominant business models and narrow economic outlooks on development, extensive declines in public spending, and the needs of developing economies, where innovation is not about cutting-edge technology but about solving social problems (Van der Have and Rubalcaba, 2016). To address these social problems, SI has the potential to alter the structure of innovation systems by imposing modifications based on the need(s) to be achieved. In other words, each social problem requires a different system and structure to satisfy its needs. Thus these changes present new challenges for policy and

management practice (Van der Have and Rubalcaba, 2016). Therefore, the fourth fundamental premise for SI is:

SIP4: Social innovation incurs a wide range of changes in strategies, structures, and frameworks needed for social transformation.

To innovate socially and succeed, financial resources are required to start up, grow, and achieve the main goals of the whole process (Moore et al., 2012; Harding, 2007, Bloom and Chatterji, 2009) and traditional finance services might not offer the required capital needed (Nicholls, 2010; Moore et al., 2012). Consequently, the concept of 'social finance' started to emerge, especially in the bottom-up innovation. Social finance refers to the deployment of financial resources primarily for social and environmental returns, and in some cases, a financial return through new types of asset class such as impact investing or micro-finance, innovations at the fund level, and funds created from competitions and grants (Moore et al., 2012). SI can also create social finance in itself (Moore et al., 2012) where "Social finance, therefore, is more than just the flow of money into social or environmental projects. It is conceived as an ethos about the way money is used" (Nicholls and Pharoah, 2007, p. 2). Accordingly, social finance contributes to the success of bottom-up SI processes. Therefore, the fifth fundamental premise of the SI process is:

SIP5: Social innovation relies on social finance resources for radical transformational changes, especially for bottom-up innovation.

SI is an iterative, interactive process that is shaped and pioneered by a wide array of actors, called 'players' in the SI process. Players in SI include communities, institutions, government bodies, individuals, social enterprises, and/or a combination of these groups. Communities and individuals mutually help in identifying the problems related to the public including those related to health, education, housing, employment, and transportation (Benneworth and Cunha, 2015). To achieve the communities' and individuals' needs, institutions play a vital role in developing innovation capabilities and requirements (Rao-Nicholson et al., 2017). In addition, institutions influence the structure of societies and how they change based on social norms, values, and traditions (Cajaiba-Santana, 2014). Accordingly, institutions, including social enterprises, work to produce new ideas and new kinds of social systems that solve social problems that arise through the broad exchange of knowledge and resources. In addition to institutions, government bodies help meet the evolving social needs of the society and seek to

enhance their social capital through cross-sector partnerships to solve larger social and environmental challenges (Maclean et al., 2013). Therefore, the sixth fundamental premise of the SI process is:

SIP6: Social innovation includes a network of players that shape its dynamics including individuals, communities, institutions, government bodies, and social enterprises.

New and rapidly evolving technology transforms SI practices and strategies. The new generation of technologies affects SI and its application. For instance, digital technology including information and communication technology improves access to resources, strengthens social capital and networked relationships, enhances the outcomes, and enlarges the value to the whole society with respect to speed, cost, and quality. Presently, there are six popular new-age technologies (NATs) that are profoundly influencing SI's capabilities and incurring significant transformative shifts in society. These six dominating NATs include internet of things (IoT), artificial intelligence (AI), machine learning (ML), 3D printing, drones, and blockchain. Ultimately, NATs in SI facilitate spreading the advantages, almost in all the sectors (such as health, education, manufacturing, safety), to far-flung places covering the majority of the populace. Therefore, the seventh fundamental premise of the SI process is:

SIP7: Social innovation is moderated by the role of new-age technologies (NATs) adoption to enhance its efficiency and effectiveness.

4. Marketplace Evidence of NAT-driven SI

We now discuss NATs (especially the six popular technologies) and their real-world applications, as applicable from the domain of SI (for both top-down and bottom-up approaches). Table 4 contains a few marketplace evidence of NATs based SIs.

Insert Table 4 here

Internet of Things. The IoT is a term generally applied to a network of connected devices communicating with each other and with human beings (Xia et al., 2012; Lee et al., 2013). Initiated in reference to RFID technology, it equips computers with data gathering, observational, and analytical abilities without human dependence and intervention (Ashton, 2009), also containing a system of smart devices embedded in everyday objects which are connected via the internet (Kopetz, 2011). An Ericsson report estimates the possible number of IoT devices by 2022 to be nearly 18 billion, with a projected growth of 21% CAGR between

2016 and 2022.[1] These devices include wearable health trackers, traffic sensors, climate sensors, logistic trackers and tags, etc. Atzori et al. (2010) categorize five key areas in which IoT are highly applicable: transportation and logistics, healthcare, smart environment, personal and social uses, and futuristic ideas. With specific regards to SI, IoT are instrumental in designing smart cities, assisted living, environment monitoring and ecological conservation, sustainable agricultural practices, education, and healthcare.

Artificial Intelligence. AI can be defined as a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation (Kaplan and Haenlein, 2019). This is accomplished through the modeling of biological and natural intelligence using a set of algorithmic models (Engelbrecht, 2008). The domain of AI systems covers logic, deductive reasoning, expert systems, case-based reasoning, and symbolic machine learning systems. A significant impact of AI is expected on multiple aspects of our lives which is predicted to grow rapidly in the near future (Makridakis, 2017).

Digital Farming is one such area, where AI can contribute significantly towards agriculture sustainability by assisting farmers with crop monitoring, predictive analysis, and supply chain management. For example, Chinnavenkateswarlu, a groundnut farmer from Andhra Pradesh, India, makes use of AI technology to find out the best time for seed sowing instead of relying on traditional wisdom by consolidating the historical data on soil moisture and rainfall. He innovated the Moisture Adequacy Index (MAI) to forecast optimal sowing time based on each crop's water requirement. The MAI helped to eliminate seed wastage and ensure better crop management, translating into 30% higher yields when compared to traditional sowing methods.[2] Later with the collaboration of Microsoft and a non-profit organization ICRISAT (International Crop Research Institute for the Semi-Arid Tropics) an app was developed to provide efficient decision making on seed sowing to millions of Indian farmers. MAI, is a perfect example, where a bottom-up SI, become top-down SI with the help of business firm and non-profit organization and able to vast spread the benefits and generate greater value.

Machine Learning. ML is an extension of AI applications concerned with studying and modeling the learning process (Michalski et al., 2013). The main objective of ML is predictive

[1] https://www.ericsson.com/en/mobility-report/internet-of-things-forecast
[2] https://news.microsoft.com/en-in/features/ai-agriculture-icrisat-upl-india/

modeling for unseen items using algorithms (Mohri et al., 2012) and further enables algorithms to learn and adapt in order to solve an assigned problem. It has widespread applications in manufacturing, fraud detection, stock market prediction, medical diagnosis, telecommunication, vision/speech recognition, and robotics (Alpaydin, 2009). It is expected that ML applications can significantly contribute towards society wellbeing by addressing critical social issues.

For example, a top-down SI by Columbia's largest financial institution, Bancolumbia, uses ML to bring financial solutions to a larger section of society through their mobile banking options.[3] Bancolumbia uses a complex algorithm to analyze transaction data to uncover suspicious cases of fraud and money laundering, which allowed Bancolumbia to introduce a resource effective (less manpower and investments) solution and make a move for financial inclusion in Columbia. In the case of bottom-up SIs, a group of individuals developed a tool for malaria and other vector-borne diseases diagnosis in the field (Delahunt, 2015). The tool comprised of a low-cost automated digital microscope along with ML algorithms, efficiently diagnose malaria and other parasite-borne diseases in the field. This further provides an estimation of the number of parasites per 8000 white blood cells (parasitemia) and yields benefits in healthcare by providing an accurate, reliable, and quick detection tool for many parasitic diseases[4].

3D Printing. 3D printing is defined as an additive manufacturing process that builds an object layer by layer. This is an alternative to traditional subtractive manufacturing and construction techniques (Berman, 2012, Kietzmann et al., 2015), which remove excess material through various processes such as grating, scraping, and dissolving from a block of material to achieve the desired result. The process begins with a computer-aided design (CAD) and is executed with the help of computer-aided engineering/manufacturing (CAE/CAM). Its direct benefits include open-source collaborations, a high degree of design customization, low-input costs in labour and material, flexibility of materials (from human cartilage to titanium), the ability to cater to underserved people, and time saving (De Jong and De Bruijn, 2013; Cohen et al., 2014; Petrick and Simpson, 2013). 3D printing has a potential to exhibit a democratizing effect on design and manufacturing (Rifkin, 2012) and its market is expected to grow at high

[3] https://www.european-microfinance.org/sites/default/files/document/file/Accelerating_Financial_Incusion_with_New_Data_-_FINAL.pdf
[4] https://www.technologyreview.com/s/600779/artificial-intelligence-offers-a-better-way-to-diagnose-malaria/

speed both in developed and developing countries and to exceed $21 billion in revenue by 2020 (Wohlers Report, 2014). 3D printing also enables the designing and printing of color-toned prosthetics for people of all races, and superhero designs (e.g., Ironman) for children, which offers psychological benefits along with health and economic ones. It is expected to bring transformative contribution in many areas of SI such as healthcare, education and research, environment conservation, public utilities, and construction.

Drones. The term 'drone' refers to an unmanned aerial vehicle either autonomous or remotely operated (D'andrea, 2014; Floreano and Wood, 2015). While the earliest history of drones begins with military warfare and espionage, their use has since been extended to disaster relief, border surveillance, fighting wildfires, terrain mapping, etc. by government agencies. The popularity of drones for civilian use picked up after advances in technology-enabled autonomous operations of drones, maneuverability in confined spaces, and the easing up of regulatory issues concerning drones (Floreano and Wood, 2015). Since then, drones have found many uses such as forest and wildlife conservation, road and highway monitoring, agriculture, animal farming, development of smart cities, disaster management, healthcare, construction, logistics, and journalism (Smith, 2015; Pere et al., 2012; Sterbenz, 2016; Agatz, 2018; Tremayne and Clark, 2014). The lowering expenses of drone acquisition and usage, development of small lightweight drones, and their easy availability have led drones to become a part of many SI projects. Choi-Fitzpatrick (2014) highlights the key principles of drone use by social movements. These include the do not harm policy, subsidiarity, physical and material security, privacy, data protection, and public interest.

Blockchain. Blockchain is a distributed database solution that maintains a continuously growing list of data records that are confirmed by the nodes participating in it (Yli-Huumo et al., 2016). Blockchain networks may be either (a) permissioned blockchains, comprised of proprietary networks such as banks, or (b) permissionless blockchains, comprised of public open-source networks such as Bitcoin (Michael et al., 2018). Certain key characteristics of blockchain technology include immutable and real-time record keeping, anonymity for network users, susceptibility to hacking, and unanticipated and ambiguous tax implications in case of blockchain currency, trust, peer-to-peer sharing, versatility, and cryptography (Michael et al., 2018; Seebacher and Schuritz, 2017). Iansiti and Lakhani (2017) mention blockchain as a foundational technology that has the potential to create economic and social systems.

Akshaya Patra, a non-profit organization based out of India, in collaboration with Accenture Labs, makes use of blockchain technology for creating sustainable solutions.[5] Akshaya Patra, a community kitchen, provides mid-day meals to 1.6 million school-going children every day. Blockchain, IoT, and AI technologies helped Akshaya Patra to improve their predictions for meal requirements, feedback mechanisms, food preparation processes, audit systems, and funding. Blockchain technology also has the potential to carry out disruption in the ride-sharing economy by facilitating new ride-sharing avenues, such as the prototype developed by Arcade City, a group of developers.[6] Their solution decentralizes ride-sharing as opposed to the centralized operations of Uber and Lyft. Another example of community-mobilized blockchain solutions comes from 'democracy.earth', a non-profit online community of hackers and thinkers from around the globe.[7] They offer 'sovereign', an open-source and decentralized democratic governance protocol that leads to transparency and greater trust in governance systems.

The marketplace evidence mentioned above indicates that SI driven by NATs can bring transformative changes in society. To better understand the deployment process to extract maximum value out of NAT-driven SI, we interviewed 12 stakeholders and experts in the domain.

5. Field Interviews

Given that this is a new area of research, one of the authors interacted with leading innovation experts from both the business world[6] and the academic community [6] to understand the challenges /impediments to produce SI. Over an extended discussion that lasted an average of 45 minutes, the key factors that were mentioned most often aligned with the following factors: Technology readiness, people/community engagement levels, how much marketing support is available, the quality of the country's infrastructure, and the willingness to adopt any SI by the concerned population.

Combining all the fundamental premises discussed above, and insights from marketplace evidence and expert interviews, we define SI (especially in the age of disruptive technologies) as a " *multidimensional construct encompassing a varied set of social actors collaborating for the*

[5] https://bitcoinmagazine.com/articles/using-blockchain-iot-boost-meal-programs-schoolchildren/
[6] https://www.forbes.com/sites/bernardmarr/2018/02/09/why-blockchain-could-kill-uber/#281d708b4179
[7] https://www.democracy.earth

social good, providing sustainable solutions for prevalent social issues, and building the social capital in the given community by bringing transformative changes in the society facilitated by technological capabilities".

6. A Conceptual Framework to Understand the Role of NAT-driven SI

Based on the triangulation approach, we propose a conceptual framework to understand the role of NAT-driven SI. Accordingly, we propose that NAT-driven SI (in the form of top-down and bottom-up SI) influence the firm, customer, and community outcomes (comprising of productivity, social inclusion, financial inclusion, employment, health, environment, and low-cost products). Further, we propose moderating factors that influence the impact of SI on firm outcomes. Specifically, we propose that the technology readiness index and country infrastructure differentially moderate top-down and bottom-up SI; marketability moderates bottom-up SI; and both consumer willingness to adopt and community engagement moderate top-down SI. Figure 1 illustrates the proposed framework.

Insert Figure 1 here

6.1. NAT-driven SI

SI can be initiated by various sets of actors situated in the society at any level of aggregation depending on the intended project or problem to address. In this study, we propose and categorize socially occurring SI as having either a top-down approach (SI initiated by actors such as organizations and government bodies, mostly in a formal setup) or a bottom-up approach (initiated by individuals or sets of individuals in an informal setup).

In top-down SI, the catalysts and change agents hail from the formal institutional setup, such as public agencies, business organizations, policy-makers, and non-profit social organizations, receiving formal support from an institution. The NAT-driven SI is viable in the top-down approach in the presence of funds, policies, and provisions of the economies of scale to create and disseminate at a larger scale in the society. In the bottom-up approach, an individual or a set of individuals from the community takes the initiative to address a social problem with their accumulated knowledge and skills. The likelihood of providing the more realistic solution is high in this scenario given that the innovators are either experiencing the problem themselves and/or are sensitive towards the daily struggles of the members of their community.

In the presence of sophisticated new-age technologies, SIs are displaying a vast potential to bring about transformative changes in society. However, innovation, in general, is also witnessing a few critical shifts. First, the shift in the relations among the actors playing a significant role in developing the SI emphasizes that innovation will be no longer be shaped and initiated by the industries and big multinationals alone. Rather, it will be significantly influenced and informed by the local knowledge and age-long learning of the target segment of society. This shift focuses on collaboration and engagement among participants in the process to make the innovation useful and efficient in a holistic way. Another shift concerns the dismantling of boundaries between the different institutional logics, which manifests transformative SI in themselves. Additionally, public-private partnerships should play a critical role in the process of SI. At the global level, such partnerships can strengthen the understanding of SI and foster the impact of SI worldwide. Therefore,

P1: The use of NATs provides a higher likelihood of successful top-down and bottom-up SI, compared to the non-use of NATs.

6.2. Outcomes

6.2.1. Firm outcomes

SI has become even more important for sustainable economic growth in recent years, as SI can solve some of the world's major issues with innovative solutions such as mobile money transfer, distance learning, organic farming, etc. Economists have estimated that between 50 and 80 percent of economic growth comes from innovation and new knowledge. This new knowledge is able to bring profound changes in existing beliefs, practices, resources, and social power structures. The new-age technology-induced SI may also play a pivotal role in economic growth by serving new markets (underserved segments) requiring sustainable social solutions and providing a dynamic way of thinking about social enterprises and entrepreneurship, firms-society engagement, and the interconnectedness of various society stakeholders[8]. In the future, the firms adopting new-age technologies will be more productive (accruing impactful outcomes such as better precision, low-cost customization, and better consumer reach) than firms with static technologies. Such innovations can be instrumental in the growth of new job markets and ancillary industries contributing to the overall economic prosperity at both the societal and national levels.

[8] https://ssir.org/articles/entry/social_innovation_creates_prosperous_societies#

The rise of social entrepreneurs and social enterprises not only contributes to the mobilization of people in the innovation process but also provides the impetus for economic growth and social equality. This is partly because some of the barriers to lasting and sustainable economic growth (such as climate change, youth unemployment, aging populations, and increased social conflicts) can be overcome only with the help of SI, and partly because of rising demands for alternative models of economic growth that enhance rather than damage human relationships and well-being. For example, in Africa, considerable advances in social and economic growth have been made over the last few years. Because of the global recession, Africa hit the low GDP percentage (i.e., 2.4 percent) in 2009, However, compared to other regions, Africa was able to make a rapid recovery since the downturn and is now regarded as the second fastest-growing continent, after Asia, and its GDP is expected to rise by an average of over 6% a year between 2013 and 2023[9] (August, 2013). Though this acceleration in Africa's economic growth was credited to fundamental improvements in macroeconomic policies, an improving business environment, and growing political stability in many African countries, equally critical are an increased focus on science, technology, and innovations to drive economic growth, and an increased focus on SI and social engineering to improve human well-being. In fact, technology-based SI, driving social changes and economic development, have become the norm among African youth and women, and there has been an increasing demand for other critical transitions such as the shifting focus from research and development (R&D) to research for development (R4D), and from technology transfers to the development of endogenous skills and knowledge-based innovation driving social changes for sustainable growth[10].

6.2.2. Community outcomes

Social Inclusion. The World Bank Group defines social inclusion as "the process of improving the ability, opportunity, and dignity of those disadvantaged based on their identity to take part in society." Social inclusion is a multi-dimensional phenomenon which affects various life domains: economic, political, cultural, and social. The integrating processes do not act independently of one another. New-age technologies such as AI, robotics, 3D printing, and drone-based SIs can transform the society's landscape by providing the products and services best suited to the marginalized community, enhancing its overall self-esteem and well-being by

[9] http://www.worldbank.org/en/region/afr/overview
[10] https://ssir.org/articles/entry/social_innovation_creates_prosperous_societies#

providing better resources and facilities to be used at its disposal. The critical question here is: with these disruptive technologies and innovations, is it possible to be so inclusive that the entire world can be embraced? Hence, the idea of inclusion is equally relevant to all beings who are excluded from society for any given reason; it should not be just be targeted to the marginalized segment. For example, people with hearing disabilities are socially excluded. The next generation hearing aid devices use image identification and neural networks to provide a better hearing experience to people with hearing disabilities and allow them to be a part of society with due dignity. Adapting such innovations with 3D printing can further reduce the cost and enhance the reach of the product serving the ostracized segment. Likewise, The KiberaNet wireless information and communication network empowered more than 2 million slum dwellers in Kenya by providing them with education and opportunities using fiber optic cables and solar power. DadaabNet did the same for refugee camps by integrating the slums and refugees into the formal economy and nurturing their sustainable development.

Financial Inclusion. As per The World Bank, financial inclusion means that "individuals and businesses have access to useful and affordable financial products and services that meet their needs – transactions, payments, savings, credit, and insurance – delivered in a responsible and sustainable way"[11]. Though the definition of financial inclusion emphasizes the accessibility of financial services, the use of access is equally critical when it is linked with the marginalized segment of society. The occurrence of new-age technologies, such as blockchain, AI, and other fintech advancements exhibit an enormous potential for reconfiguring the entire understanding of financial inclusion by empowering both the demand and supply side. At the supply side, financial institutions are now equipped with better data and analytics to make better decisions, and at the demand side, the customers feel empowered by receiving previously inaccessible services and the credit facility to make their lives better and help them to get out of poverty. A mobile money payment system born out of SI, M Pesa, could alter the lives of 9 million people in East Africa by providing them with access to secured financial exchange services, which previously was not feasible due to poor banking infrastructure and rigid financial regulatory frameworks. Likewise, in Senegal, mobile money regulation coupled with digitization policies, opened up large market potential with regard to mobile money issuers and increased access to financial services. Though the rise of fintech innovation and the availability of big data provide

[11] https://www.worldbank.org/en/topic/financialinclusion/overview

small businesses and marginalized community members with easy access to the credit facility and banking services and make them feel more included in the society, it is also critical to maintaining a balance between the fintech innovation and protecting consumers' interests. Some nations are setting up regulatory checks for any discrepancy. For example, Malaysia and Kenya have set up regulatory sandboxes to keep a watch on the innovation in a controlled live environment to better observe the potential risks and future opportunities.

Having an inclusive community combats discrimination, develops intercultural competence, and stimulates the entrepreneurial environment, thereby yielding a greater number of innovations for the societal good.

Employment. With the emergence of new technologies, it is expected that technologies such as robotics, drones, and 3D printing would shirk manpower requirements for various industries and cause major unemployment issues worldwide. However, there may be a brighter side to the story, as the disposal of disruptive technology may bring a new set of industries related to leisure, entertainment, and creativity and would provide new avenues to indulge in. However, when the technologies are used for the social good, it can actually alleviate the unemployment problem by assisting the firms to select the best resources from the potential population. For example, Pymetrics[12], a startup firm which helps organizations find candidates beyond resumes by leveraging neuroscience and AI, works with organizations to uncover candidates that closely match their top performers. By using user-friendly games, Pymetrics measures attributes that better and more fairly predict a candidate's success. Also, under their 'Impact Hiring' initiative, organizations hire 'opportunity youth': aged 18-24 who are neither in school nor at work, and who have an employment rate of over 12% -- three times the national average (of the US). The effort is to hire 'Opportunity Youth' and diversify the workforce by using AI to highlight their potential over their pedigree and helping organizations to select individuals who are the right fit for the jobs regardless of their background or previous access to opportunity. We in this study propose to use technology and technology-related SIs to provide access to jobs and financial independence to this unique, high-potential population.

Health. New-age technology-based SIs contain the potential to achieve sustainable development goals, especially in the area of healthcare. Particularly in developing countries, it is

[12] https://www.forbes.com/sites/fridapolli/2018/01/30/ai-for-social-impact/#2c5793b7343d

critical to supply effective healthcare facilities in remote areas, as along with the high cost, it is also challenging to monitor the process throughout. Smart IoT devices, AI, 3D printing, and big data analysis can help to manage critical health-related global issues, advance the human health ecosystem, provide a real-time stream of information, improve the effectiveness and efficiency of the available resources, and facilitate effective decision making among the administrators and policymakers. For example, IoT devices can monitor blood glucose and track heart-rate, and AI techniques can be deployed to predict potential health hazards and provide early warnings.[13] Such technology connected with smartphones can provide information on the required nutritional and exercise routines to help the user maintain their health.

3D printing technology also provides a simpler, lower-cost, and faster way of manufacturing complex products and components, as well as new effective prototyping of the upcoming innovation, significantly facilitating inclusion in the healthcare sector. For example, South Africa's Centre for Rapid Prototyping and Manufacturing at the Central University of Technology, Free State, manufactured 3D-printed titanium jaws at an effective cost for Kimberley Hospital (APANEWS, 2014; Diamond Fields Advertiser, 2015). However, there are some critical boundaries: most 3D printers can only use one material at a time, rather than the combination of materials commonly required for prosthetic limbs. Hence there are higher chances that 3D-printed models may not be able to reconstruct the interface between prosthetic limbs and soft tissue (Andrews, 2013). A clear understanding of such trade-offs and mechanisms is essential for the consideration of such applications. Conscientious efforts are required to encourage regulators and policymakers to incorporate such SIs into the social system.

Environment. Big data, the IoT, disruptive AI algorithms, and powerful applications such as drones and 3D printing are not only radically altering our lives, but they are also generating hope for the rescue of our planet. The existing situation of human health hazards due to the deteriorating natural environment is a major worry at the global level. New-age technologies, such as AI, provide an opportunity to transform the traditional order of business in various sectors, systems, and industries to develop and build sustainable cities and countries, and to protect biodiversity and overall human wellbeing. For example, Deepmind,[14] by using ML in their Google data centers, was able to decrease their energy usage drastically. The implications

[13] https://www.transform.global/modules/Content/NewsDetail.aspx?appId=2&NewsId=030867f7-bd86-4f64-b781-d4e5304e8819
[14] https://www.forbes.com/sites/fridapolli/2018/01/30/ai-for-social-impact/#2c5793b7343d

of this accomplishment have great potential to reduce emissions, improve energy efficiency globally, and reduce Google's data center cooling bill by 40%.

The World Economic Forum[15] in collaboration with PWC and Stanford Woods Institute for the Environment recently launched a report on "harnessing AI for the Earth" and suggested that AI applications hold the potential to address surging environmental issues. The report has suggested a few priority action areas: a) ***smart agriculture systems*** involve the use of AI and robotics in agriculture to automate data collection and decision making, to more quickly detect critical issues related to crops and livestock, and to provide solutions in real-time streaming. This will further enhance the resource efficiency of the agriculture industry by lowering the usage of water, safeguarding it from climate extremes, and facilitating the minimal usage of fertilizers and pesticides which cause damage to the entire ecosystem; b) ***weather and climate prediction*** using AI (i.e., climate informatics) will transform weather forecasting and improve the performance of multi-folds with the use of deep learning networks which allow the fast computing of complex data to provide real-time updates; c) ***smart cities*** wherein, a smart dashboard can be created to optimize city sustainability by employing augmented and virtual reality (AR and VR), and real-time city-wide data on energy, weather, water consumption and availability, traffic, and people flow; d) ***autonomous and connected electric vehicles*** using AI-guided vehicles will ensure the mobility and efficient use of energy and help in route optimization for smooth traffic and effective autonomous ride-sharing platforms; e) ***distributed energy grids*** involving IoT and AI can be used to predict the demand and supply for renewable energy across the grids, improve energy storage and efficient load management, facilitate integration and reliability of renewables, and enable dynamic pricing and trading.

6.2.3. Customer outcomes

Rapid technological change and technology-based innovations are transforming the entire supply chain of the production of goods and services almost at a global level. A research report from the World Economic Forum and A.T. Kearney, titled "Technology and Innovation for the Future of Production[16]," suggests that four technologies will dominate the production in the years to come: the IoT, AI, advanced robotics, and 3D printing. It is recommended that the real strength of these technologies rests in their convergences with one another. Hence, understanding

[15] http://www3.weforum.org/docs/Harnessing_Artificial_Intelligence_for_the_Earth_report_2018.pdf
[16] http://www3.weforum.org/docs/WEF_White_Paper_Technology_Innovation_Future_of_Production_2017.pdf

and planning for such convergence is the key to unlocking the highest value of future production systems.

Industries with a high labor cost or a high cost of production errors have the greatest potential to achieve a significant return on investment (ROI) with these technologies. For example, technology such as augmented reality (AR) and virtual reality (VR) will be able to reduce workforce/employee training costs and requirements and are expected to increase training effectiveness. With the inclusion of such disruptive technologies in the production process, the cost-per-unit is expected to decrease even in the absence of economies of scale. Also, in communities and nations where service cost is high, the inclusion of robots in the production process can reduce the serving cost and facilitate widespread adoption of the given services. Likewise, the role of 3D printing in SI can be phenomenal where customization is critical, volumes are low, and the product contains high-value parts that enhance the overall cost of the product. 3D printing enables production at low cost, with specific requirements, and with little to no waste, and is sometimes capable of recycling the original material, helping to create a circular economy as well. This can be a game changer in the field of medical equipment, the automobile industry, and the aerospace industry. In the future, disruptive technologies, if handled well, can bring significant value to society.

The scaling up of the innovation and reaching out to the concerned segment is easier in top-down SI because of the operational, technical, and marketing support an innovation received from the firms/ formal institutions. Also, because of the available high capital investments, it is possible for the formal institutions to develop the innovation at the low cost, availability of NAT based infrastructure and hence capacity to produce more. However, the bottom-up SIs, initiated by the socially conscious people, get the higher tractions from the society because of the higher acceptability and its immediate positive effect on the given environment. Therefore, it is expected that

P2a: The NAT driven top-down SI will lead to the creation of greater firm outcomes (i.e., productivity) and customer outcomes (i.e., low-cost products) compared to the NAT driven bottom-up SI.

P2b: The NAT driven bottom-up SI will lead to the creation of higher community outcomes (i.e., social inclusion and financial inclusion, employment, health, and environment) compared to the NAT driven top-down SI.

6.3. Moderating factors

6.3.1. Technology Readiness Index

The capability and readiness of all the stakeholders to absorb new knowledge and transform it into innovation are fundamental to any effective innovation system. The readiness of the system to absorb the transformative innovation, especially in the domain of SI, can be considered as a prerequisite to achieving the optimum outputs. The predominance of disruptive technologies in the new-age industrial revolution demands the adoption of technological skills as the utmost priority (see UNCTAD, 2017a). With fast-paced technology, environments may portray mismatches between the available innovations and the readiness of the target market. In this new-age technology-based SI landscape, there is a need for stakeholders -- especially users who are equipped with core and fundamental skills (basic academic, numeric, and digital) -- to better adopt the innovation. In fact, internet connectivity (especially in developing economies) is the basic requisite for adopting any technological innovation. Under these circumstances, educational and R&D policies must respond with a high level of agility, transformative education and training, and infrastructure setups for the stakeholders to keep pace with the changing environment.

Anticipating the required changes in the relevant skillsets may facilitate the design of better education and training policies to swiftly fill in the mismatches. In fact, big data and AI can play an important role in predicting such changes and identifying skill shortages. This process demands a dynamic, collaborative approach including all the actors and stakeholders, from policymakers to big enterprises, and from educationists to the final users (Riad, 2017). Therefore,

P3: A higher technology readiness index strengthens the relationship between NAT-driven SIs (i.e., bottom-up and top-down) and SI outcomes (i.e., firm, community, and customer).

6.3.2. Country infrastructure

The infrastructure of the country, along with conducive policies and provisions toward innovation, comprises the basic infrastructure (e.g., water, energy, ICT, transport and urban structures), specialized infrastructure supporting R&D, demonstration and innovation (such as laboratories and equipped R&D facilities), and existing technologies. Availability of the basic infrastructure is one of the critical factors encouraging innovation in the country, as it facilitates the interactions and mobility of the populace and allows its members to exchange information

and knowledge at a local and global level. In the presence of inadequate infrastructure, some developing countries develop a few selected geographical locations, such as special economic zones, industrial parks, science and technology parks, and business incubators, providing specialized infrastructure for such facilities with supporting policies and provisions to nurture and support their productivity and transformative ideas (UNCTAD, 2015b). Such initiatives may derive synergy effects and foster local development, which has effects on other communities and businesses as well. Having a reliable technical infrastructure brings multiple benefits to the community and prepares businesses to withstand the competitive marketplace together with providing and disseminating affordable, accessible, and sustainable products and services for the social good.

Policymakers can develop an environment for innovation and foster the growth of science, technology, and innovation in society. A step towards encouraging innovation in Finland[17] has been taken by the government's main advisory body on science, innovation, and research (SITRA), which recommended that innovativeness should be a critical criterion for competitive bidding in the public procurement process. Therefore, the diffusion of innovative ideas is encouraged in the society by the government, if the given innovation is able to provide a sustainable solution at a competitive cost. The further recommendation suggests that a part of the funding for government departments should be allocated to the innovation and development activities for the society. Therefore, it is expected that

> *P4: A favourable country infrastructure will strengthen the relationship between NAT-driven SIs (i.e., bottom-up and top-down) and SI outcomes (i.e., firm, community, and customer).*

6.3.3. Consumer willingness to adopt

A person's willingness to adopt refers to his/her state of preparedness and readiness to choose, approve, or accept something. In the case of innovation adoption, Rogers (1962) suggested that the key to adoption is that the given idea, product, or service is perceived as new or novel by the people. The adoption of innovation is based on five factors: relative advantage, compatibility, complexity, trialability, and observability. The relative advantage of the innovation refers to whether the user sees a given product as a better value proposition than the

[17] https://ssir.org/articles/entry/game_changing_technology_is_not_enough

existing product. However, in the case of SI, the product can be an entirely new idea and would require a new set of skills, knowledge, and behavioral change at the user's end to address the existing social concerns. Accordingly, an innovation has to be compatible with the existing value system and needs of the user. At the same time, innovation should not be too complex to be understood by users.

In the case of NAT-driven SI, products may appear to be too complex for the user to adopt in his/her daily life; however, with the right set of training and awareness, along with the pre-trial of the product provided by the developers and the firms, such concerns can be resolved. The triability of the new product offers an avenue to test and experience the product before the final purchase. Consequently, the users should be able to observe the value in the usage of the product. Moreover, in the context of SI, the low cost of the given product would also stimulate the diffusion and adoption of the innovation. SI that is primarily targeted to the broader segments of society, including the marginalized segment, should be able to address these broader concerns. Even the best technology in the world would not be able to diffuse well if it is not able to bring about a difference in people's lives. Understanding the customer's concern is all the more critical in the top-down approach of SI, where the innovators, developers, and distributors do not necessarily hail from the concerned community for which the product has been designed. Until the users feel that the product genuinely addresses their problems, it is challenging to make them adopt the same. Therefore, following the customer centricity concept, in the top-down approach, developers of SI should be listening to the needs of the customers and taking their unbiased feedback at every stage of the innovation process. When consumers are willing to adopt the given top-down SI there are higher possibilities that they tend to believe in the innovation initiated by the trusted brand/institution; hence, they may end up buying and using more of it. This will enhance the productivity of the firm and facilitate economies of scale, resulting in the low-cost products available for the end users. Higher willingness to adopt will have a significant effect on the community outcomes because with the high level of production, low-cost of the product and better marketing avenues top-down SI will bring in far reached outcomes in the society by empowering the community/society facilitating the better provisions and inclusions. Hence,

> *P5: Compared to bottom-down SI, a higher consumer willingness to adopt top-down SI will lead to greater community-based outcomes than firm based and customer based outcomes.*

6.3.4. Community engagement

Community engagement can be defined as a process or set of activities in which the members of the civil society (such as citizens, non-profit groups, and informal groups) are involved, participating in the process of social innovation by developing and deploying novel solutions for addressing prevalent social concerns. Such engagements are critical, especially in the case of top-down SI in motivating public trust in public institutions and policymakers, generating social capital and social cohesion among local communities, and effectively and efficiently using of resources.

Additionally, in the context of top-down SI, the four essential dimensions to community engagement have been suggested by TEPSIE (2014): First, *bringing knowledge* refers to the process through which the community and/or the community people bring significant contribution in creating the right set of SI using their tacit and indigenous knowledge about the community needs and available resources. This dimension of community engagement encourages the democratic view of SI in society and further fosters a sense of empowerment among the populace. Second, the *divergent thinking* of a community (or of the public) provides a rich source of novel ideas facilitating solutions to complex social issues. The wide-ranging perspective sets innovators/developers on a creative route, circumventing traditional heuristics, thereby allowing them to think differently without getting stuck in conventional thinking (Jeppesen and Lakhani, 2010). Third, *managing complex problems* refers to social issues that cannot receive an immediate solution by developing an innovative product or service. Such issues at times defy the top-down solution provided by the regulators and policymakers as they may introduce conflict at various levels in the society structure. Hence, only with the gradual shift in the thought process and consumption behavior of the community can such complex social problems be managed. Fourth, the *legitimacy of the projects* can be significantly increased by involving the community in the ideation to the implementation phase. It is expected that the participation of the community in the innovation process (especially in the decision-making process) provides them with a sense of democracy and therefore legitimizes the project with a higher degree of acceptance of the given SI.

The dimensions discussed above strongly recommend the unique contributions of the community engagement in the context of SI; and hence, we suggest that it will positively effect

the SI outcomes. The engaged community will share more of their knowledge and indigenous skills which will assist in developing the low–cost product in the presence of NAT enhancing the customer outcomes. Plus, the engaged community will also purchase more of such SIs and will enhance the firm productivity. This altogether will bring better diffusion of SIs in the society bringing in the positive contribution, hence the given SIs will be able to create much higher community-based outcomes such as social and financial inclusion, employment and better health and environment. Therefore, it is expected that firm and customer related outcomes will be enhanced in the presence of community engagement, and this effect would be further higher on community-based outcomes. In order to receive the maximum benefit of community engagement though it is important that the people are engaged in the process, however, the individuals with a vested interest should be prevented from participating. Also, given the uncertainty factor that exists in the process of open collaboration, all the stakeholders (especially the policy makers and business firms) should be prepared for the possibility of unanticipated outcomes. Therefore,

P6: Compared to bottom-down SI, a higher community engagement towards top-down SI will lead to greater community-based outcomes than firm based and customer based outcomes.

6.3.5. Marketing support

When the given SI is developed by policymakers, regulators, or business enterprises, it is easier to disseminate the awareness and offering across the targeted segment given the resources these actors hold in the top-down approach. Often, such innovations are imposed in society when regulatory bodies attempt to bring transformative social changes. For example, the electronic biometric identity, Aadhar card, was introduced by the government of India not only to regularize the benefits and subsidies given to the poor segment of society, abolishing corruption and irregularities in the process, but also to empower them socially and financially in a sustained way.

However, when the SI is developed in an informal setup by an individual and/or community (bottom-up approach), though the diffusion of the innovation to bring the maximum benefit is dependent on its marketability (i.e., the ability of an offering to be sold and marketed, and its attractiveness to the potential buyers and users). Further, given the resources required for the technology-intense SI, it is challenging to disseminate in the society. For the farthest reach of the innovation and its benefits, the collaboration with the business firms and intervention of the

relevant governmental department should be encouraged for the purpose of further development of the product, scaling up, and distribution. The concerned government department can also facilitate the diffusion and adoption of the SI by organizing workshops and creating dedicated centers in the vicinity to impart the skillset to both the innovators (to better market their product) and the users (to develop the usage skill) in order to maximize the benefits. Therefore,

P7: Compared to top-down SI, a higher marketing support for a bottom-up SI will lead to greater firm based and customer based outcomes than community-based outcomes.

7. Implications for Firms, Policymakers and Social Entrepreneurs

There are a few critical questions to be put forward to better understand the context of SI in the presence of disruptive technologies and which should be comprehended by all the stakeholders. How can new-age technologies be incorporated to offer solutions to society's problems? How can such innovative solutions be adequately diffused in society to gain the optimum benefit? What combination of actors would provide the maximum benefits and reach of the given SI? What is the optimum supply chain process (related to both the upstream and downstream activities) to adopt to optimally diffuse the technology-related SIs? This paper makes an attempt to address a few of the above-raised questions and provides a couple of implications for the firms, policymakers, social entrepreneurs, and society individuals to receive the best output.

First, the normative application of SI assumes that technology-based SI can bring leapfrog transformation to society, but can also be challenged if not desirable or germane to the interest of society and the targeted populaces (Howaldt and Schwarz, 2010). The literature also suggests that "there is no inherent goodness in social innovation" (Lindhult 2008), that the benefits and effects of SI depend on the point of view, and that the benefits can be ambivalent even in the case of technology-based SI (Howaldt and Schwarz, 2010). What may act as a social good to one segment at a given time, or in a certain social region or community, may prove irrelevant or even detrimental elsewhere (Franz et al.,2012). The innovator has to understand the perceptions and uses of the end user. A close understanding of the ecosystem and the needed integration of the associated contexts are required to create an impact on the targeted communities, i.e., whether the end users are equipped with the basic technology usage to adopt the AI- and ML-based innovations. It is observed that sometimes the targeted segment can be

well prepared (from the idea stage to the final product) by the innovation bodies to better accept the innovation once it is on the market.

Hence, given the fact that SIs are highly complex and context-dependent, the various challenges and unintended outcomes may occur at different stages in the process of SI. It is the responsibility of the innovation body (either top-down or bottom-up) to look at the opportunities and challenges, and pay attention both to the holistic social development issues and to how an effective integration of technologies into the communities, institutions, and societies would help to reduce inequities.

Because disruptive technologies such as AI, ML, and robotics have far-reaching consequences which may affect social, political, and economic rights especially when integrated with SIs, it is critical to ensure that these powerful technologies are upholding the principles of fairness, accountability, and transparency. To achieve this, it is crucial to have an efficient, integrated, and diverse system in place. The integrated approach would ensure that the dataset is complete, standard, and collected with precision, and it would further confirm that the presented data is a true reflection of the reality[18]. This process would lower the uncertainty at various stages in the process of innovation from the risk of identifying a false problem (which may seem critical when it is not), to over-emphasizing or overlooking the social inequalities, to being overoptimistic about the SI outcomes. At the same time, incorporating diversity in the process of SI development is equally critical, as this suggests that the teams which are diverse in nature are efficient in problem-solving. Having diversity from design to deployment of technology-based SI would facilitate explicit attention to inclusivity in the process. This would nurture the fundamental principle of SI to be as inclusive as possible and minimize unintended prejudices. Hence, various actors participating in either of the innovation approaches (top-down and/or bottom-up) should ensure that the data-based application is carefully managed and foster trust in the stakeholders for better adoption rate.

Encouraging SI in society brings multifaceted advantages. The diligent focus of policymakers, large industrial enterprises, and social entrepreneurs on providing solutions to prevalent social problems can yield prosperity in society. The process of developing SI is inclusive in nature, bringing multiple stakeholders to act together to make it workable. The SI concept works with an understanding that the role of society and individuals is also to provide

[18] https://www.weforum.org/agenda/2017/09/applying-ai-to-enable-an-equitable-digital-economy-and-society/

high-quality services which are beneficial and affordable to the society, adding value in the day to day lives of the populace. Both the policymakers and the government, along with initiating SI initiatives, can further encourage and facilitate the bottom-up SI initiatives for their sustainable execution and placement. Large business corporations can create new business opportunities, extend their support, and collaborate with social entrepreneurs in developing relevant SIs for addressing social issues.

The central core of the SI concept rests with the conglomeration of the various groups and segments of the society from the development to the deployment to the usage stages. Hence, along with the collaborative approach, the actors associated with the innovation process should be encouraged to adopt design thinking (which emphasizes the cognitive, strategic, and practical processes) and system thinking (which emphasizes the interrelation and interdependence of the parts) to arrive at the greatest possible social good.

8. Future research

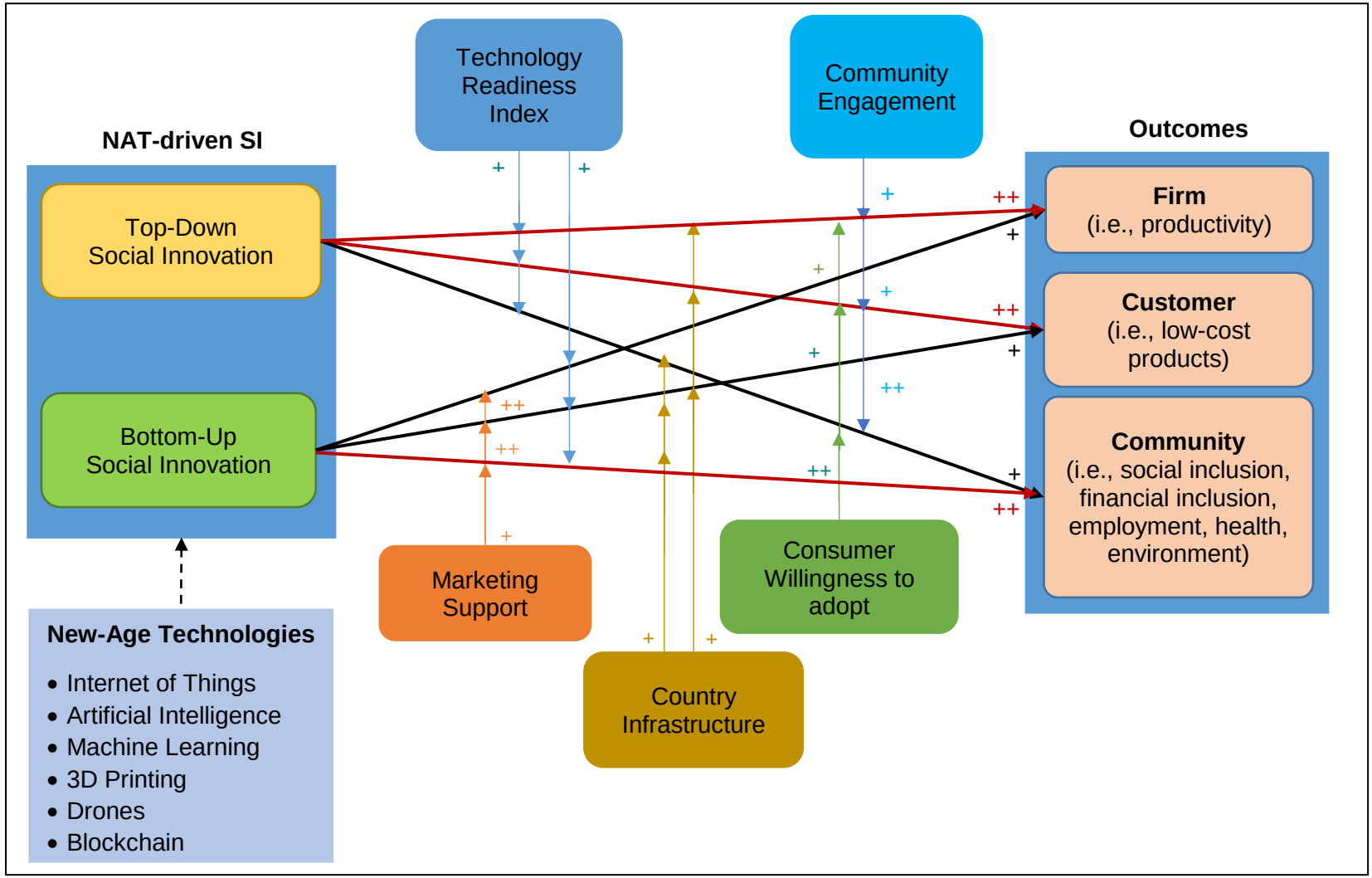
Future research can examine the synergy effect between technological innovation and SI. This can be explored across the globe in various nations to identify the pattern of the SI occurrence. Also, it would be motivating to know- why in some societies and communities SIs spawn naturally? The answer to this question can bring interesting facts to the surface to further investigate the factors fertile to the development of a socially conscious society. Also, there exists a prevalent gap in the understanding of SI among policymakers, practitioners, non-profit organizations, funding bodies, and community people. In the absence of a common comprehension of the subject, the entire process of SI lacks a synergy effect. The collaboration, engagement, and cooperation cannot yield the desired outcomes until all the stakeholders speak the same language. Hence, a comprehensive understanding of SI terminology in various contexts (such as country-wise, technology-wise) should be explored and well documented. It is understandable that in general, SI is all about bringing change in the existing system, and such systemic change demands a dynamic framework for it to be adopted. Future research can work on categorizing the factors according to their nature (i.e., dynamic and static) and look into their interconnectedness and effect on SI. The existing study provides a framework for new-age technology-influenced SIs and the benefits it brings to society within the given boundary conditions. In this research, authors suggest that the distinction between top-down and bottom-up

SI is fading away and all the actors should be coming together to create an impactful SI. The future research can identify those conditions and factors when such distinctions will fade away, especially in the context of disruptive technology-based SI.

Additionally, the measures of the suggestive outcomes should be developed to validate the framework. Can this framework be adopted by all the nations to understand the technology-based SI? Further work can compare and contrast this framework across various nations or categorize the moderating factors and outcomes separately for developed and developing nations. The empirical validation of the proposed framework can identify the hitches and provide explanations for better implementation.

Moreover, future research may develop a framework and/or an understanding around the concern of whether profit and purpose can go together in SI. This can be accomplished only when all the actors participating in the process come together, irrespective of their identity as a public or private entity, and collaborate for the social good. At the same time, entities should be able to create avenues to generate profit out of such social initiatives for their long-term sustainability. In the future, to build a sustainable business model, it is essential for a business to follow the triple bottom line (TBL) approach -- no matter if the business focuses on the needs of the mainstream markets or society as a whole.

Figure 1 – A Conceptual Framework for Understanding NAT-driven Social Innovations



Legend: ++ denotes a strong positive effect, and + denotes a positive effect

Driven by ++ effect + effect

Table 1 – Classification of Innovation Forms

	Bottom-up Innovation	Top-down Innovation
Firm-led Innovation	**Feedback from stakeholders:** • Importance of interacting with all stakeholders for the successful development and implementation of innovations (Hall, 2003; Hart and Sharm, 2004). • Stakeholder theory (Freeman, 1984) and the resource-based view of the firm (Barney, 1991) have been used to understand the communication dynamics that can foster innovation. • Research has sufficiently studied the process of developing and managing customer knowledge to drive innovation (Lynn et al., 1996; Joshi and Sharma, 2004; Van de Ven and Polley, 1992). • Later research has focused on the creation of firm value from customer-contributed knowledge. In this regard, Kumar et al. (2010) conceptualized the customer knowledge value (CKV) metric that refers to the monetary value attributed to a customer by a firm due to the profit generated by implementing an idea/suggestion/feedback from that customer. Indeed, the customer feedback channel has the potential to make the entire offering more attractive to existing and potential customers, apart from improving process efficiencies (Kumar et al., 2010).	**Research & development activities:** • Studies have identified a firm's R&D activities as critically impacting the innovation process (Gupta, 1986; Crépon, 1998). Specifically, the level of internal firm learning and its ability to learn from partners jointly determine a firm's innovation performance (Sampson, 2007). Other studies have posited that whereas manufacturers are more likely to innovate through in-house R&D efforts and intellectual collaborations with educational institutions, service firms are more likely to collaborate with customers and suppliers for their innovation efforts (Leiponen, 2005; Tether, 2005). **Frugal innovation:** • Frugal innovation refers to a constraint-based innovation that begins with recognizing the needs of poor consumers in developing newer solutions (Wooldridge, 2010). It is developed on the concept of being prudent in the use of resources (Zeschky et al., 2011; Sharma and Iyer, 2012; UNCTAD, 2018). In addition, it is also known to be specific to emerging markets (especially India) to develop effectively affordable offerings (Khilji, 2013; Cappelli, 2010; Petrick and Juntiwasarakij, 2011). • *Examples:* the development of portable electrocardiogram by GE in India (Immelt et al., 2009), and a low-cost refrigerator that works without electricity was developed by India-based Mitticool (Rao, 2013). **Reverse innovation:** • Reverse innovation is defined as innovations first developed in and for the emerging markets that are later adopted in developed markets (Govindarajan, 2011). It is an extension of frugal innovation that operates at a product level (Zeschky et al., 2014), but reverse innovation operates at a market level. • *Recent examples originating from India include* GE's hybrid distributed power system; Bosch's transport management system to manage vehicles and aircraft fleets; and Siemens' 3D-printed component for steam turbines. These innovations are now being used in other emerging and developed markets (Dhamija, 2018).

Customer-led Innovation	**Grassroots innovation (GRI):** • GRI enables local communities and individuals (especially from economically disadvantage segment) to convert their ideas into products and services by creatively using their indigenous knowledge to solve their localized problems in an affordable and sustainable way (Gupta, 2019). • *Examples include* the India-originated Honey Bee Network and People's Science Movements, and the Brazil-originated Social Technologies Network (Fressoli, 2014). **Jugaad innovation:** • Developed around the concept of 'doing more with less,' refers to quick and improvised solutions to temporary problems (Radjou et al., 2012). It has been referred to as a frugal, flexible, and inclusive approach to innovation and entrepreneurship emerging from India (Prabhu and Jain, 2015). • This concept parallels innovation approaches from other world regions such as gambiarra or jeitinho in Brazil, jiejian chuangxin in China, DIY (do-it-yourself) in the United States, and Systeme D in France (Prabhu and Jain, 2015; Agnihotri, 2015). • *Examples in India include* the Solar Electric Lighting Company, the Nokia 1100 mobile handset model, and the inclusion of 'missed calls' into a mobile marketing strategy.	**Customer co-creation:** • The literature on customer co-creation (from an innovation viewpoint) is rich and informative (Bogers, 2010; Hoyer et al., 2010; Sawhney et al., 2006; Mahr et al., 2014). Ramaswamy and Ozcan (2018) define co-creation as "the enactment of interactional creation across interactive system-environments (afforded by interactive platforms), entailing agencing engagements and structuring organizations." (p. 200) • Based on this definition, they develop the concept of value-in-interactional creation that recognizes the interactivity of firms and customers, the presence of interactive platforms, and the focus on value creation. • *For instance*, to develop the Nightclub of the Future – a highly charged and trendy nightclub in Milan -- Heineken interacted with 100 clubbers from around the world and engaged 19 designers to transform the insights learned into an engaging party space (Labarre, 2012). Similarly, initiatives such as Lego's IDEAS website, Dell's Idea Storm website, P&G's Connect + Develop platform, and Starbucks' My Starbucks Idea are examples of recent successes in co-creation. Such marketplace practices demonstrate how interactions, multiple digital platforms, and value generation arise out of co-creation efforts.
Community-led Innovation	**Social Innovation (initiated by a socially-conscious individual(s))** • Mulgan et al. (2007) define social innovation as innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organizations whose primary purposes are social. SI has been conceptualized to benefit the broader community rather than specific (or a group of) individuals. • Popular examples include microfinancing (e.g., Grameen Bank), human rights (e.g., Amnesty International), education (e.g., the open university system), environmental sustainability (e.g., emissions trading or cap and trade), and sustainable trade practices (e.g., fair trade certified products), among others.	**Social innovation (initiated by organizations)** • From a stakeholder perspective, SI has been defined as seeking new answers to social problems by identifying and delivering new services; and by implementing new labor market integration processes that contribute to improving the position of individuals in the workforce (OECD, 2010). SI has also been effectively used in the business community in growing the brand or firm or profits, through product design (e.g., Apple's iPod), user community (e.g., Linux and Wikipedia), and crowdsourcing (e.g., Amazon M-Turk). In other words, SI can be driven not only by individuals rooting for a cause, but also by larger entities' carrying forward the ideas of change and betterment that have emerged elsewhere in the society (Mulgan, 2006).

Table 2 – Comparison of the Popular Forms of Innovation on Specific Traits

	Frugal innovation	**Reverse innovation**	**Grassroots innovation**	***Jugaad* innovation**	**Social innovation**
Focus	Product-based	Market-based	Product-based	Product-based	Need-based
Key benefits	Cost, value	Cost, value, novelty	Value	Cost	Value
Fit	Regional, national	Global	Regional	Hyper-local	Regional, national
Scalability	Moderate	High	Moderate	Low	Moderate
Sustainability	Moderate	Moderate	High	Low	Moderate
Knowledge type	Formal	Formal	Formal	Informal	Formal
Sophistication	Moderate	High	Moderate-High	Low	Moderate-High
Cost-effectiveness of the solution	High	High	Moderate	High	Moderate
Level of production	High	High	Moderate-High	Low	Moderate-High
Sourcing of inputs	Regional	National	Regional	Local	Regional

Table 3 – Conceptualization of Social Innovation in Previous Studies

Study	Definition	Dimension
Drucker (1987)	Social innovation is viewed as a "mass movement that has a behavior of its own and an identity of its own. It is not irrational; on the contrary, it is highly predictable" (p.31). In addition, social innovation is described as a 'managerial task' accomplished by private, non-governmental organizations after being a form of the governmental and political act.	Managerial and process-outcome-value
Cloutier (2003)	"The instrumental perspective considers the reorganization of labor as a key factor of the innovative capacity of the firm without any regard for the well-being of workers. Social innovation refers thus to a new social arrangement which promotes the creation of knowledge and technical innovation" (p.21)	Social
Moulaert et al. (2005)	Social innovation is "path-dependent and contextual. It refers to those changes in agendas, agency, and institutions that lead to a better inclusion of excluded groups and individuals in various spheres of society at various spatial scales" (p.1978)	Social and socioeconomic
Mulgan (2006)	Social innovation is "innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly developed and diffused through organizations whose primary purposes are social" (p.6)	Social
Callon (2007)	Social innovation relates to "the organization of markets and co-construction of emergent concerned groups and their integration into the processes of design and production of new goods and services" (p.159)	Economic and stakeholder
Adams and Hess (2008)	Social innovation is viewed as "mold-breaking ways of confronting unmet social need by creating new and sustainable capabilities, assets or opportunities for change" (p.3)	Social
Murray et al. (2010)	Social innovation is defined as "new ideas (products, services, and models) that simultaneously meet social needs and create new social relationships or collaborations. In other words, they are innovations that are both good for society and enhance society's capacity to act" (p.3)	Social and stakeholder
Phills et al. (2008)	Social innovation is defined as "a novel solution to a social problem that is more effective, efficient, sustainable or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals" (p.36)	Process-outcome-value
Hochgerner (2009)	Social innovations are "new concepts and measures that are accepted by impacted social groups and are applied to overcome social challenges"	Sociological
Pol and Ville (2009)	Social innovation is redefined as "implied new idea has the potential to improve either the quality or the quantity of life" (p.881)	Sociological
Dawson and Daniel (2010)	Social innovation is described as "the process of collective idea generation, selection and implementation by people who participate collaboratively to meet social challenges" (p.16)	Social
Howaldt and Schwarz (2010)	Social innovation is "new combination and/or new configuration of social practices in certain areas of action or social contexts prompted by certain actors or constellations of actors in an intentional targeted manner	Sociological

	with the goal of better satisfying or answering needs and problems than is possible on the basis of established practices" (p.16)	
OECD (2010)	"Social innovation seeks new answers to social problems by: identifying and delivering new services that improve the quality of life of individuals and communities; identifying and implementing new labour market integration processes, new competencies, new jobs and new forms of participation, as diverse elements that each contribute to improving the position of individuals in the workforce"	Stakeholder
Westley and Antadze (2010, p. 2)	Social innovation is "a complex process of introducing new products, processes or programs that profoundly change the basic routines, resource and authority flows, or beliefs of the social system in which the innovation occurs. Such successful social innovations have durability and broad impact" (p.2)	Social
Caulier-Grice et al. (2012)	"New solutions (products, services, models, markets, processes, etc.) that simultaneously meet a social need (more effectively than existing solutions) and lead to new or improved capabilities and relationships and better use of assets and resources. […] both good for society and enhance society's capacity to act" (p.18)	Social
Neumeier (2012)	Social innovation is defined as "changes of attitudes, behavior or perceptions of a group of people joined in a network of aligned interests that in relation to the group's horizon of experiences lead to new and improved ways of collaborative action within the group and beyond" (p.55)	Sociological
European Commission (2013)	Social innovation can be defined as "the development and implementation of new ideas (products, services and models) to meet social needs and create new social relationships or collaborations" (p.6)	Social
Ruiz and Parra (2013)	Social innovation is defined as " the design and implementation process as well as a process of disseminating new social practices and policies to promote change in the social organization of people to promote economic ends"	Sociological and economic
Cajaiba- Santana (2014)	Social innovations are "new social practices created from collective, intentional, and goal-oriented actions aimed at prompting social change through the reconfiguration of how social goals are accomplished" (p.3)	Structural and sociological
This study	Social innovation is a multidimensional construct encompassing a varied set of social actors collaborating for the social good, providing sustainable solutions for prevalent social issues, and building the social capital in the given community by bringing transformative changes in the society facilitated by technological capabilities.	Multidimensional

Table 4 – Real-world applications of Social Innovation Approaches in Developed and Developing Markets

	Bottom-up Social innovation (initiated by socially-conscious individuals)		Top-down Social innovation (initiated by organizations)		Social Innovation in developed & developing markets
	Innovation	**Benefits**	**Innovation**	**Benefits**	
IoT	Environment monitoring by volunteers using devices with sensors.[1]	1) Reliable and unbiased monitoring 2) Agility in responding to dangerous environmental issues 3) Citizen empowerment	Consolidation of medical data and records using IoT.[2]	1) Improved prognosis 2) Medical and hospital management 2) Agility in offering medical treatments	• Hitachi Ltd., realized the sheer volume of clinical patient data from diagnostic tests to previous medical records, and data from wearable health devices to clinical data from hospitals. Hitachi's healthcare innovation combined hardware, software, services, and data systems to bring about effective information management. [2] • A Japan-based citizens' community used IoT to integrate data from volunteers' devices monitoring radiation data following the Fukushima disaster using "bGeigie Nano", a compact radiation data measuring sensor that tracks not only radiation, but also the time and GPS coordinates of each captured data. [3]
AI	Development of educational tools for people with autism.[4]	1) Accessible learning tools for people with autism and learning disabilities 2) Easier exploration of human cognitive thinking	Digital farming.[5]	1) Improved crop yield 2) Reduction in wastage of seeds 3) Farmer community empowerment	• Wildbook is an AI-based program that can identify animals by their unique coat patterns or other hallmark features. Presently, this program runs databases for 20 species.[6] • Nike's flagship premium store, Nike House of Innovation, has merchandise fitted with a QR code for Nike Plus members to scan with their app, either to buy immediately in their size or have the items sent to a changing room to try on.[7] • Shufersal Ltd., Israel's largest supermarket chain is implementing an AI-powered system that uses a feed from ceiling cameras to identify items in a customer's shopping cart, which are tallied to produce the bill.[8]
Machine Learning	Field detection of malaria and other vector-borne diseases using digital autoscope and machine learning.[9]	1) Quick diagnosis 2) Improved reliability	Fraud detection in banking services using machine learning.[10]	1) Inclusive financial development 2) Reduction in manpower requirements 3) Time-saving	• AmazonGo enables customers to skip waiting at the cash register by Amazon's cloud computing, machine learning, voice control, and logistics know-how.[11] • Using augmented reality, IKEA Place app lets users point the camera at an area and super-impose authentic-looking renderings of IKEA furniture to help design the interiors.[12]

					• In India, COCO by DHFL General Insurance uses AI and machine learning to offer a motor policy where consumers can pick and choose the coverage options, rather than buy a bundled product with features they may not need.[13]
Drones	Use of drones to identify and expose illegal forest land clearing for palm plantation.[14]	1) Relatively cheap monitoring through drones 2) Can cover large areas in a short time 3) Live video transmission possible	Use of drones to deliver medical supplies (such as blood and organs) to remote communities.[15]	1) Time-saving 2) Reach areas with poor access 3) Cheaper than other means (i.e., helicopters)	• A collaborative effort between 'Drone Adventures', a non-profit organization based in Switzerland, and a group of researchers from the University of London, led to a cartography exercise of Lima suburbs. [16] The project produced detailed maps of the area which were enriched with the intelligence gathered from the local community that were then used by locals for city planning.
	Use of drone to map disadvantaged neighborhoods to rehabilitelocal communities.[17]	1) Safe option to map dangerous terrain 3) Community empowerment	Reforestation movement by spraying of seeds by drones.[18]	1) Quick Scale up possible 2) Reduce wastage of seeds 3) Reduces manpower	• A U.K.-based start-up, BioCarbon Engineering, invented a technique for planting trees in deforested areas using drones to spray seeds. [19] The drone technique is much more efficient than spraying seeds using a helicopter, as it uses algorithms to decide the optimum area and planting strategy.
3D printing	Sustainable urban transportation using 3D printed self-driving bus.[20]	1) Sustainable and eco-friendly (electric vehicle) 2) High degree of customization 3) Safe transport option	3D printed prosthetics to reach the underserved communities specially children.[21]	1) Open source 2) High degree of customization 3) Much cheaper than traditional options	• Local Motors, an Arizona-based automobile manufacturer, used 3D printing to build an electric shuttle bus using crowdsourced design. [22] The bus, named 'Ollie,' is touted as the world's first autonomous on-demand shuttle and offers an affordable, minimalistic, and clean solution to city transport.
	Affordable housing using 3D printed houses.[23]	1) Time reduction 2) Waste reduction 3) Low cost 4) High degree of customization	3D printing of scientific equipment and models to make science education accessible.[24]	1) Open source 2) Low cost 3) Accessible and interactive teaching tools	• 'e-NABLE' is an example where a community of over 1500 members consisting of engineers, scientists, designers, doctors, caregivers, parents, philanthropists, etc. who work at making 3D-printed prosthetic limbs[21]

Blockchain	Blendhub, the world's first decentralized network for the production of powdered foods that help food growers, channel members, and customers.[25]	1) Track ingredients, raw materials, and end products from their primary source to destination 2) Guarantee proof of quality throughout the supply chain	Chinese smartphone manufacturer Transsion, is expanding its presence in Africa and India through its innovative offerings such as multi-SIM handsets.[26]	1) Incorporation of local languages for keyboards 2) Longer battery life 3) Affordable pricing 4) Tailoring to local customs	• Rackspace, a cloud and managed service provider, has introduced 'Service Blocks', a cloud service for customers using cloud environments (e.g., Amazon, Microsoft, Google), with pricing plans tailored to a company's specific stage in their cloud adoption.[27] • Alibaba's Apsara, a cloud computing system, can cluster thousands of PCs and act like a supercomputer to implement extremely powerful computing performance. In 2017, the system supported a peak of 325,000 transactions and 256,000 payment transactions per second.[28]

Footnotes:

1. https://blog.safecast.org
2. https://ww2.frost.com/frost-perspectives/social-innovation-healthcarehitachis-approach/
3. https://blog.safecast.orgdata/#.XAGDMS2B3OQ
4. https://news.vanderbilt.edu/2017/09/05/artificial-intelligence-thinks-like-people-with-autism-being-used-to-develop-educational-tools/
5. https://news.microsoft.com/en-in/features/ai-agriculture-icrisat-upl-india/
6. A. Casselman (2018), "How artificial intelligence is changing wildlife research," *National Geographic*, November 13, accessed from https://www.nationalgeographic.com/animals/2018/11/artificial-intelligence-counts-wild-animals/.
7. E. Gibson (2018), "Nike's rippled glass New York flagship aims to disrupt 'concrete canyon'," *dezeen.com*, November 14, accessed from https://www.dezeen.com/2018/11/14/nike-house-innovation-000-flagship-store-new-york-city/.
8. Y. Benmeleh (2018), "Competition to AmazonGo Is Coming From an Unlikely Source," *Bloomberg*, November 13, accessed from https://www.bloomberg.com/news/articles/2018-11-13/competition-to-amazongo-is-coming-from-an-unlikely-source.
9. https://www.technologyreview.com/s/600779/artificial-intelligence-offers-a-better-way-to-diagnose-malaria/
10. https://www.european-microfinance.org/sites/default/files/document/file/Accelerating_Financial_Incusion_with_New_Data_-_FINAL.pdf
11. A. Gaus (2018), "Is Amazon Go the Future of Retail?" *The Street*, November 12, accessed from https://www.thestreet.com/technology/is-amazon-go-the-future-of-retail--14775854.
12. B. Marr (2018), "The Digital Transformation To Keep IKEA Relevant: Virtual Reality, Apps And Self-Driving Cars," *Forbes*, October 19, accessed from https://www.forbes.com/sites/bernardmarr/2018/10/19/the-amazing-digital-transformation-of-ikea-virtual-reality-apps-self-driving-cars/#4106160276be.
13. A. Singal (2018), "This Startup is Leveraging Technology to Improve Customers' Dining Experience," *Entrepreneur*, November 13, accessed from https://www.entrepreneur.com/article/323256.
14. http://globalconservation.org/news/uav-drones-becoming-valuable-tools-fighting-illegal-deforestatio/
15. https://www.theaustralian.com.au/national-affairs/health/drones-to-deliver-medical-supplies-as-angels-of-mercy/news-story/520294978d1a8223c1c053ed447289c2
16. http://droneadventures.org/projects/using-mapping-to-empower-local-communities-in-lima-peru/
17. http://droneadventures.org/the-mapping-drone-a-democratic-tool-for-empowering-communities/
18. https://news.nationalgeographic.com/2017/11/drones-plant-trees-deforestation-environment/
19. https://localmotors.com/2017/05/15/worlds-first-3d-printed-shuttle-olli/
20. https://news.nationalgeographic.com/2017/11/drones-plant-trees-deforestation-environment/

21. http://enablingthefuture.org
22. https://www.theverge.com/2016/6/16/11952072/local-motors-3d-printed-self-driving-bus-washington-dc-launch
23. https://www.iconbuild.com/new-story/
24. https://3dprint.com/229526/3d-printing-and-electronic-components-make-neuroscience-more-accessible/
25. G. Muthoni (2018), "UN Accepts Blockchain Companies into Its One Planet Network," *Block Telegraph*, November 2, accessed from https://blocktelegraph.io/un-accepts-blockchain-companies-one-planet-network/.
26. A. L. Dahir (2018), "A low-profile, Chinese handset maker has taken over Africa's mobile market," *Quartz Africa*, August 30, accessed from https://qz.com/africa/1374404/chinas-transsion-dominates-africas-phone-market-with-tecno-itel/.
27. E. Dickinson (2018), "Rackspace unveils Service Blocks to mitigate excessive customer cloud costs," *Asia Could Forum*, November 7, accessed from https://www.networksasia.net/article/rackspace-unveils-service-blocks-mitigate-excessive-customer-cloud-costs.1541562566.
28. Z. Soo, and L. Tao (2018), "How Singles' Day has helped Alibaba ascend on an AI-powered cloud in China," *South China Morning Post*, November 10, accessed from https://www.scmp.com/tech/enterprises/article/2172253/how-singles-day-has-helped-alibaba-ascend-ai-powered-cloud-china.

References

Adams, David; Hess, Michael (2010). Social Innovation and Why It Has Policy Significance. *Economic and Labour Relations Review, 21*(2), 139–155.

Adams, D.W. and Hess, M. (2008). Social innovation as a new public administration strategy. In *The 12th Annual Conference of the International Research Society for Public Management*, 1,1-8.

Agatz, N. (2018). The benefits of combining drones and trucks for deliveries. *RSM Discovery-Management Knowledge, 33*(1), 17-19.

Agnihotri, A. (2015). Low-cost innovation in emerging markets. *Journal of Strategic Marketing, 23*(5), 399-411.

Alpaydin, E. (2009). *Introduction to machine learning*. MIT press.

Andrew, C., & Klein, J. L. (2010). SI: What is it and why is it important to understand it better. ET10003. Ontario Ministry of Research and Innovation. Toronto. *Cahiers du Centre de recherche sur les innova- tions sociales (CRISES). Collection Études théoriques*, no ET1003.

Ashton, K. (2009). That 'internet of things' thing. *RFID Journal*, *22*(7), 97-114.

Atzori, L., Iera, A., & Morabito, G. (2010). The internet of things: A survey. *Computer Networks*, *54*(15), 2787-2805.

Austin, J., Stevenson, H., & Wei-Skillern, J. (2006). Social and commercial entrepreneurship: Same, different or both? *Entrepreneurship Theory & Practice, 30*(1), 1–22.

Ayers, D., Dahlstrom, R., & Skinner, S. J. (1997). An exploratory investigation of organizational antecedents to new product success. *Journal of Marketing Research, 34*(1), 107-116.

Baker, W. E., & Sinkula, J. M. (1999). The synergistic effect of market orientation and learning orientation on organizational performance. *Journal of the Academy of Marketing Science, 27*(4), 411-427.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99-120.

BEPA (2009): Social innovation as part of the Europe 2020 strategy. Brussels: European Commission.

Benneworth, P. and Cunha, J. (2015). Universities' contributions to social innovation: reflections in theory & practice. *European journal of innovation management*, *18*(4), 508-527.

Birkinshaw, J., Bouquet, C., & Barsoux, J. (2011). The 5 myths of innovation. *MIT Sloan Management Review, 52*(2), 1-10.

Bloom, P. and Chatterji, A. (2009). Scaling social entrepreneurial impact. California management review, *51*(3), 114-133.

Bogers, M., Afuah, A., & Bastian, B. (2010). Users as innovators: A review, critique, and future research directions. *Journal of Management, 36*(4), 857-875.

Cajaiba-Santana, G. (2014). Social innovation: Moving the field forward. A conceptual framework. *Technological Forecasting and Social Change*, *82*, 42-51.

Callon, M. (2007). An essay on the growing contribution of economic markets to the proliferation of the social. *Theory, Culture & Society*, *24*(7-8), 139-163.

Cappelli, P., Singh, H., Singh, J., & Useem, M. (2010). The India way: Lessons for the US. *Academy of Management Perspectives, 24*(2), 6-24.

Carroll, J. M., & Rosson, M. B. (2007). Participatory design in community informatics. *Design studies, 28*(3), 243-261.

Caulier-Grice, J., Davies, A., Patrick, R. and Norman, W. (2012) Defining social innovation: *A deliverable of the project*: '*The Theoretical, Empirical and Policy Foundations for Building Social Innovation in Europe' (TEPSIE), European Commission–7th Framework Programme, Brussels: European Commission, DG Research. 22*.

Chambon, J.L., David, A., and Devevey, J.M. (1982). *Les innovations sociales*. Paris: Presses universitaires de France.

Choi-Fitzpatrick, A. (2014). Drones for good: Technological innovations, social movements, and the state. Journal of International Affairs, 19-36.
Cohen, D., Sargeant, M., & Somers, K. (2014). 3-D printing takes shape. McKinsey Quarterly, Jan.
Cloutier, J. (2003). Qu'est-ce que l'innovation sociale? Montreal: *Collection Études théoriques* No ET0314, CRISES.
Crépon, B., Duguet, E., & Mairessec, J. (1998). Research, innovation and productivity: An econometric analysis at the firm level. *Economics of innovation and new technology*, *7*(2), 115-158.
Daft, R. L. (1978). A dual-core model of organizational innovation. *Academy of Management Journal, 21*(2), 193-210.
Damanpour, F. (1996). Organizational complexity and innovation: Developing and testing multiple contingency models. *Management Science, 42*(5), 693-716.
Dawson, P. and Daniel, L. (2010). Understanding social innovation: a provisional framework. *International Journal of Technology Management*, *51*(1), 9-21.
Defourny, J., & Nyssens, M. (2010). Conceptions of social enterprise and social entrepreneurship in Europe and the United States: Convergences and divergences. *Journal of Social Entrepreneurship*, *1*(1), 32-53.
Dhamija, A. (2018). Reverse innovation: Made in India, for the world. Retrieved from http://www.forbesindia.com/article/innovation-nation/reverse-innovation-made-in-india-for-the-world/50029/1
Delahunt, C. B., Mehanian, C., Hu, L., McGuire, S. K., Champlin, C. R., Horning, M. P., ... & Thompon, C. M. (2015). Automated microscopy and machine learning for expert-level malaria field diagnosis. In 2015 *IEEE Global Humanitarian Technology Conference (GHTC)*(pp. 393-399). IEEE.
De Jong, J. P., & de Bruijn, E. (2013). Innovation lessons from 3-D printing. *MIT Sloan Management Review*, *54*(2), 43.
Drucker, P. F. (1985). The discipline of innovation. *Harvard Business Review, 63*(3), 67-72.
Drucker, P.F. (1987). Social innovation—management's new dimension. *Long Range Planning*, *20*(6), 29-34.
Duncan, T., & Moriarty, S. E. (1998). A communication-based marketing model for managing relationships. *Journal of Marketing, 62*(2).
Wooldridge, A. (2010). First break all the rules: The charms of frugal innovation. *The Economist*, 3-5.
Edwards-Schachter, M.E., Matti, C.E. and Alcántara, E. (2012). Fostering quality of life through social innovation: A living lab methodology study case. *Review of Policy Research*, *29*(6), 672-692.
Engelbrecht, A. (2008). *Computational Intelligence*. Hoboken: John Wiley & Sons, Ltd.
European Commission, (2013). Guide to Social Innovation. EU Commission, Brussels.
Franz HW, Hochgerner J, Howaldt J (eds). (2012). Challenge Social Innovation: Potentials for Business, Social Entrepreneurship, *Welfare and Civil Society*. Springer: London.
Freeman, R. (1984). *Strategic Management: A Stakeholer Perspective*. Englewoods Cliffs, NJ: Prentice Hall.
Fressoli, M., Arond, E., Abrol, D., Smith, A., Ely, A., & Dias, R. (2014). When grassroots innovation movements encounter mainstream institutions: implications for models of inclusive innovation. *Innovation and Development*, *4*(2), 277-292.
Godin, B. (2012). Social Innovation: Utopias of Innovation from c. 1830 to the Present. *Project on the Intellectual History of Innovation (Working Paper No. 11)< http://www. csiic. ca/PDF/SocialInnovation_2012. pdf*.
Govindarajan, V., & Ramamurti, R. (2011). Reverse innovation, emerging markets, and global strategy. *Global Strategy Journal*, *1*(3-4), 191-205.
Gupta, S. (2019). Understanding the feasibility and value of grassroots innovation. *Journal of the Academy of Marketing Science*, 1-25.

Gupta, A. K., Raj, S., & Wilemon, D. (1986). A model for studying R&D-Marketing interface in the product innovation process. *Journal of Marketing, 50*(2), 7-17.
Hall, J., & Vredenburg, H. (2003). The challenges of innovating for sustainable development. *MIT Sloan Management Review, 45*(1), 61-68.
Harding, R. (2007). Social entrepreneurship monitor. London: *London Business School and Barclays Bank.*
Hart, S. L., & Sharma, S. (2004). Engaging fringe stakeholders for competitive imagination. *Academy of Management Perspectives, 18*(1), 7-18.
Hillier, J., Moulaert, F., & Nussbaumer, J. (2004). Trois essais sur le rôle de l'innovation sociale dans le développement territorial. *Géographie, économie, société, 6*(2), 129-152.
Hobday, M. (2005). Firm-level innovation models: perspectives on research in developed and developing countries. *Technology Analysis & Strategic Management, 17*(2), 121-146.
Hochgerner, J. (2009). Innovation processes in the dynamics of social change. *Innovation cultures. Challenge and LearningSstrategy*, 17-45.
Howaldt, J. and Schwarz, M. (2010). Social innovation. *Concepts, Research Fields, and International Trends. Dortmund: Sozialforschungstelle Dortmund.*
Hoyer, W. D., Chandy, R., Dorotic, M., Krafft, M., & Singh, S. S. (2010). Consumer cocreation in new product development. *Journal of Service Research, 13*(3), 283-296.
Hubert, A. (2010). Empowering people, driving change: SI in the European Union. *Bureau of European Policy Advisors (BEPA)*, Retrieved from http://ec.europa.eu/bepa/pdf/publications_pdf/social_innovation.pdf
Hurley, R. F., & Hult, G. T. M. (1998). Innovation, market orientation, and organizational learning: An integration and empirical examination. *Journal of Marketing, 62*(3), 42-54.
Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. *Harvard Business Review, 95*(1), 118-127.
Immelt, J. R., Govindarajan, V., & Trimble, C. (2009). How GE is disrupting itself. *Harvard Business Review, 87*(10), 56-65.
Jeppesen, L.B., Lakhani K.R. (2010). Marginality and problem-solving effectiveness in broadcast search. *Organization Science, 21*(5), 1016-1033.
Joshi, A. W., & Sharma, S. (2004). Customer knowledge development: antecedents and impact on new product performance. *Journal of Marketing, 68*(4), 47-59.
Kannan, P. K. (2014). Creating social value through citizen co-creation. In R. T. Rust & M.-H. Huang (Eds.), *Handbook of Service Marketing Research* (pp. 580-607). Cheltenham, UK: Edward Elgar Publishing.
Kaplan, A., & Haenlein, M. (2019), "Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence," *Business Horizons, 62*(1), 15-25.
Khilji, S. E. (2013). The changing context of South Asian economies. In C. Rowley & S. E. Khilji (Eds.), *Globalization, Change and Learning in South Asia* (pp. 1-18). Oxford, UK: Chandos Publishing.
Kopetz, H. (2011). Internet of things. In *Real-time systems* (pp. 307-323). Springer, Boston, MA.
Kumar, V., Aksoy, L., Donkers, B., Venkatesan, R., Wiesel, T., & Tillmanns, S. (2010). Undervalued or overvalued customers: Capturing total customer engagement value. *Journal of Service Research, 13*(3), 297-310.
Labarre, S. (2012). Heineken Crowdsources Its "Nightclub Of The Future". Retrieved from https://www.fastcompany.com/1669559/heineken-crowdsources-its-nightclub-of-the-future
Lee, F. S., Vogel, D., & Limayem, M. (2003). Virtual community informatics: A review and research agenda. *Journal of Information Technology Theory and Application, 5*(1), 47-61.
Lee, G. M., Crespi, N., Choi, J. K., & Boussard, M. (2013). *Internet of things.* In *Evolution of Telecommunication Services* (pp. 257-282). Springer, Berlin, Heidelberg.

Leiponen, A. (2005). Organization of knowledge and innovation: the case of Finnish business services. *Industry and Innovation, 12*(2), 185-203.
Lindhult, Eric (2008). Are Partnerships Innovative? In: Lennart, Svensson/ Barbro, Nilsson (eds.):Partnership – *As a Strategy for Social Innovation and Sustainable Change*. Stockholm: Satéruns Academic Press, 37-54.
Lööf, H., & Heshmati, A. (2002). Knowledge capital and performance heterogeneity: A firm-level innovation study. *International Journal of Production Economics, 76*(1), 61-85.
Lynn, G. S., Morone, J. G., & Paulson, A. S. (1996). Marketing and discontinuous innovation: the probe and learn process. *California Management Review, 38*(3), 8-37.
Maclean, M., Harvey, C. and Gordon, J. (2013). Social innovation, social entrepreneurship and the practice of contemporary entrepreneurial philanthropy. *International Small Business Journal*, *31*(7), 747-763.
Mahr, D., Lievens, A., & Blazevic, V. (2014). The value of customer cocreated knowledge during the innovation process. *Journal of Product Innovation Management, 31*(3), 599-615.
Makridakis, S. (2017). The forthcoming Artificial Intelligence (AI) revolution: Its impact on society and firms. *Futures*, *90*, 46-60.
Marinova, D. (2004). Actualizing innovation effort: the impact of market knowledge diffusion in a dynamic system of competition. *Journal of Marketing, 68*(3), 1-20.
Matsuno, K., Mentzer, J. T., & Özsomer, A. (2002). The effects of entrepreneurial proclivity and market orientation on business performance. *Journal of Marketing, 66*(3), 18-32.
Matsuo, M. (2006). Customer orientation, conflict, and innovativeness in Japanese sales departments. *Journal of Business Research, 59*(2), 242-250.
Menguc, B., & Auh, S. (2006). Creating a firm-level dynamic capability through capitalizing on market orientation and innovativeness. *Journal of the Academy of Marketing Science, 34*(1), 63-73.
Michael, J., Cohn, A., & Butcher, J. R. (2018). BlockChain technology. *The Journal*, *1*, 7.
Michalski, R. S., Carbonell, J. G., & Mitchell, T. M. (Eds.). (2013). *Machine learning: An artificial intelligence approach*. Springer Science & Business Media.
Mieg, H.A. and Töpfer, K. (Eds.). (2013). *Institutional and social innovation for sustainable urban development*. Routledge.
Miller, D. (1983). The correlates of entrepreneurship in three types of firms. *Management Science, 29*(7), 770-791.
Mohri, M., Rostamizadeh, A., & Talwalkar, A. (2012). *Foundations of machine learning*. MIT press.
Moore, M.L., Westley, F.R. and Nicholls, A. (2012). The social finance and social innovation nexus.
Morris, M. H., & Paul, G. W. (1987). The relationship between entrepreneurship and marketing in established firms. *Journal of Business Venturing, 2*(3), 247-259.
Moulaert, F., Martinelli, F., Swyngedouw, E. and Gonzalez, S. (2005). Towards alternative model (s) of local innovation. *Urban Studies*, *42*(11), 1969-1990.
Moulaert, F. and Nussbaumer, J. (2005). The social region: beyond the territorial dynamics ofthe learning economy. *European Urban and Regional Studies, 12*(1), 45–64.
Mulgan, G. (2006a). *A manifesto for social innovation: What it is, why it matters and how it can be accelerated*. London: The Young Foundation.
Mulgan, G. (2006). The process of social innovation. *Innovations: technology, governance, globalization, 1*(2), 145-162.
Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007). *Social innovation: What it is, why it matters and how it can be accelerated*. Working Paper Series. Skoll Centre for Social Entrepreneurship. Oxford, UK.
Murray, R., Caulier-Grice, J. and Mulgan, G. (2010). *The open book of social innovation* (p. 2). London: National endowment for science, technology and the art.

Neumeier, S. (2012). Why do social innovations in rural development matter and should they be considered more seriously in rural development research?–Proposal for a stronger focus on social innovations in rural development research. *Sociologia Ruralis*, *52*(1), 48-69.
Nicholls, A. (2010). The institutionalization of social investment: the interplay of investment logics and investor rationalities. *Journal of Social Entrepreneurship*, *1*(1), 70–100.
Nicholls, A. and Pharoah, C. (2007). *The landscape ofsocial investment: A holistic topology ofopportunities and challenges*. Oxford: Skoll Centre for Social Entrepreneurship.
OECD. (2010). Social Entrepreneurship and Social Innovation *SMEs, Entrepreneurship and Innovation* (pp. 185-217). Paris: OECD Publishing.
OECD/Eurostat. (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation* (4 ed.). Paris/Eurostat, Luxembourg: OECD Publishing.
August, O. (2013). "Africa rising A hopeful continent". *The Economist, 2*. Retrieved 7 May 2019.
Petrick, I. J., & Juntiwasarakij, S. (2011). The rise of the rest: Hotbeds of innovation in emerging markets. *Research-Technology Management, 54*(4), 24-29.
Petrick, I. J., & Simpson, T. W. (2013). 3D printing disrupts manufacturing: how economies of one create new rules of competition. *Research-Technology Management*, *56*(6), 12-16.
Phills Jr, J. A., Deiglmeier, K., & Miller, D. T. (2008). Rediscovering Social Innovation. *Stanford Social Innovation Review, 6*(4), 34-43.
Phillips, W., Lee, H., Ghobadian, A., O'Regan, N. and James, P. (2015). Social innovation and social entrepreneurship: A systematic review. *Group & Organization Management*, *40*(3), 428-461.
Pol, E. and Ville, S., 2009. Social innovation: Buzz word or enduring term?. *The Journal of Socio-economics*, *38*(6), 878-885.
Prabhu, J., & Jain, S. (2015). Innovation and entrepreneurship in India: Understanding jugaad. *Asia Pacific Journal of Management, 32*(4), 843-868.
Radjou, N., Prabhu, J., & Ahuja, S. (2012). *Jugaad innovation: Think frugal, be flexible, generate breakthrough growth*: John Wiley & Sons.
Ramaswamy, V., & Ozcan, K. (2018). What is co-creation? An interactional creation framework and its implications for value creation. *Journal of Business Research, 84*, 196-205.
Rao, B. C. (2013). How disruptive is frugal? *Technology in Society*, *35*(1), 65-73.
Rao-Nicholson, R., Vorley, T. and Khan, Z. (2017). Social innovation in emerging economies: A national systems of innovation based approach. *Technological Forecasting and Social Change*, *121*, 228-237.
Rodríguez Herrera, A., & Alvarado Ugarte, H. (2008). *Claves de la innovación social en América Latina y el Caribe*. Santiago de Chile: CEPAL.
Rifkin, J. (2012). The third industrial revolution: How the internet, green electricity, and 3-d printing are ushering in a sustainable era of distributed capitalism. *World Financial Review*, *1*(1), 4052-4057.
Ruiz, C., Parra, C. (2013). New forms of organization in knowledge-based societies: social innovation. In: *Non-profit Organizations and Social Entrepreneurship*. Routledge, New York, N.Y.
Sampson, R. C. (2007). R&D alliances and firm performance: The impact of technological diversity and alliance organization on innovation. *Academy of Management Journal*, *50*(2), 364-386.
Sawhney, M., Wolcott, R. C., & Arroniz, I. (2006). The 12 different ways for companies to innovate. *MIT Sloan Management Review, 47*(3), 75-81.
Schumpeter, J. A. (1934). *The theory of economic development*. Cambridge, MA: Harvard University Press.
Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy* (5 ed.). New York, NY: Harper and Brothers.
Seyfang, G., & Smith, A. (2007). Grassroots innovations for sustainable development: Towards a new research and policy agenda. *Environmental Politics*, *16*(4), 584-603.
Sharma, A., & Iyer, G. R. (2012). Resource-constrained product development: Implications for green marketing and green supply chains. *Industrial Marketing Management*, *41*(4), 599-608.

Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M., & Seyfang, G. (2016). Making the most of community energies: Three perspectives on grassroots innovation. *Environment and Planning A, 48*(2), 407-432.

Smith, K. W. (2015). *Drone technology: Benefits, risks, and legal considerations*. Seattle J. Envtl. L., 5, i.

Sterbenz, J. P. (2016, June). Drones in the smart city and iot: Protocols, resilience, benefits, and risks. In *Proceedings of the 2nd Workshop on Micro Aerial Vehicle Networks, Systems, and Applications for Civilian Use* (pp. 3-3). ACM.

TEPSIE (2014), Social Innovation Theory and Research: A Summary of the Findings from TEPSIE. *A deliverable of the project: 'The theoretical, empirical and policy foundations for building social innovation in Europe' (TEPSIE), European Commission–7th Framework Programme, Brussels: European Commission, DG Research, 22.*

Tether, B. S. (2005). Do services innovate (differently)? Insights from the European innobarometer survey. *Industry and Innovation, 12*(2), 153-184.

Thomke, S., & Von Hippel, E. (2002). Customers as innovators: a new way to create value. *Harvard Business Review, 80*(4), 74-85.

Tremayne, M., & Clark, A. (2014). New perspectives from the sky: Unmanned aerial vehicles and journalism. *Digital Journalism, 2*(2), 232-246.

UNCTAD. (2018). *Harnessing Frontier Technologies for Sustainable Development*. Retrieved from Switzerland: https://unctad.org/en/pages/PublicationWebflyer.aspx?publicationid=2110

Van de Ven, A. H., & Polley, D. (1992). Learning while innovating. *Organization Science, 3*(1), 92-116.

Van der Have, R.P. and Rubalcaba, L., 2016. Social innovation research: An emerging area of innovation studies?. *Research Policy*, *45*(9), 1923-1935.

Von Hippel, E. (2005). *Democratizing innovation*. Cambridge and London: MIT Press.

Westley, F. and Antadze, N. (2010). Making a difference: Strategies for scaling social innovation for greater impact. *Innovation Journal*, *15*(2).

Williams, K., & Durrance, J. C. (2008). Social networks and social capital: Rethinking theory in community informatics. *The Journal of Community Informatics, 4*(3), 1-20.

Xia, F., Yang, L. T., Wang, L., & Vinel, A. (2012). Internet of things. *International Journal of Communication Systems, 25*(9), 1101-1102.

Zeschky, M., Widenmayer, B., & Gassmann, O. (2011). Frugal innovation in emerging markets. *Research-Technology Management, 54*(4), 38-45.

Zeschky, M. B., Winterhalter, S., & Gassmann, O. (2014). From cost to frugal and reverse innovation: Mapping the field and implications for global competitiveness. *Research-Technology Management, 57*(4), 20-27.