


Chapter

Sustainable Entrepreneurship and Innovation. Addressing the Grand Challenges through Radical Change and Open Innovation.

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Abstract: Sustainable Entrepreneurship and Innovation are essential tools in the transition towards a more fair, healthy, and sustainable society. This chapter gives an overview of the two decades of research on the topic and discusses the current state of its application. It shows that the current literature lacks a more profound theoretical and practical investigation. Nevertheless, these gaps may be covered soon, as the number of publications in this area is growing. Additionally, the chapter explores the importance of a radical approach, open innovation strategies, and collaboration to foster sustainable entrepreneurship and innovation and tackle the Grand Challenges of modern society.

Keywords: open eco-innovation, eco-innovation, collaboration, cooperation, sustainable entrepreneurship, sustainable innovation

1. Introduction

Our society currently faces a number of pressing economic, social, and environmental issues that lead to instability, social unrest, and environmental dangers. In the recent management literature, these issues are branded as the "Grand Challenges and defined as "specific critical barrier(s) that, if removed, would help solve an important societal problem with a high likelihood of global impact through widespread implementation" (George et al., 2016, p. 1881). The range of these issues is vast and spans from reducing social inequality and reducing poverty to fighting Global Warming. The most widely accepted list of challenges compiled by the UN comprises 17 Sustainable Development Goals

(SDGs) and 169 targets that have to be achieved by 2030. These pressing issues are not new, and many essential measures were taken in the past to mitigate them or at least alleviate the possible consequences. Traditional approaches and ideas that dominate the current literature on sustainability proved to be successful to a certain extent. Despite the common negative narrative, our society made significant advancements to substantially increase humans' quality of life in the last century. The number of people living in extreme poverty dropped from over 80% to less than 20%, the cost of food dropped by 20 times, the cost of energy fell by 100 times, the global income per capita tripled, the lifespan of a human being doubled, child mortality rates decreased from more than 40% to less than 5%, and the number of the illiterate population decreased from over 80% to less than 20% (Diamandis & Kotler, 2012). Nevertheless, many of the Grand Challenges are still left unresolved, including social inequality, economic turmoil, and the current declining state of democracy.

One of the most critical issues today is Global Warming and environmental degradation, where the rate of implementation of sustainable practices does not match the speed of caused destruction, and previous measures failed to provide the necessary and timely solutions (IPCC, 2019). The growing scientific evidence suggests that humanity is on the brink of an environmental crisis. We have only a decade to restrain human inflicted global warming under 1.5°C above pre-industrial level (IPCC, 2019). 2°C global warming could cause a domino-like cascade of biogeophysical feedbacks in the Earth System and push it towards irreversibly higher temperatures and onto a "Hothouse Earth" pathway (Steffen et al., 2018), that will make our Planet a hostile and unpredictable place to live.

The Intergovernmental Panel on Climate Change clearly states that Global Warming and environmental degradation is a result of human activities (IPCC, 2019). The simple equation formula of Human Environmental Impact (IPAT) suggests that the influence of society on the Planet depends on the size of the human population, its affluence (propensity for consumption), and technology ($I=P \times A \times T$) (da Silva Rabêlo & de Azevedo Melo, 2019). It is projected that the human population continues to grow and will reach its maximum (10-20 billion) around 2050 to 2100, before stabilizing and declining (Mullan & Haqq-Misra, 2019). SDG's objectives to meet the basic human needs in developing countries (Leal Filho et al., 2019) and the challenges of degrowth in developed nations (Büchs & Koch, 2018) make it challenging to curb global consumption and, ultimately, global production. Consequently, technology may be the only solution to achieve drastic results in decreasing environmental impact and increasing the quality of life of human beings in a short and mid-term period.

Traditionally, innovation is linked to production growth, competitive advantage, and economic gains (Casey, 2004; Smith et al., 2010). However, the growing number of studies focus on the technical potential (Long & Blok, 2018;

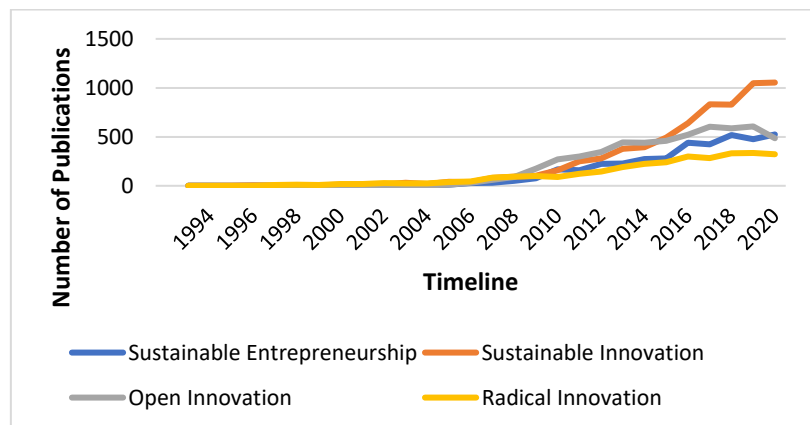
Saguy, 2011) and ethical obligation of innovation (Inigo et al., 2020) to provide solutions for major societal challenges. These kinds of innovations are called Sustainable Innovations (SI), and today they are positively changing the status quo in many failing areas of our society. Originally, SI was promoted through governmental agencies and big corporations, with large R&D departments. However, the vast scope of current challenges requires the participation of broader sections of society, including SME's and startups (Yun & Yigitcanlar, 2017). The realization of SI in the market by entrepreneurial firms is called Sustainable Entrepreneurship (SE) (Schaltegger & Wagner, 2011). According to OECD (2009), SE and SI are viable and essential solutions for a broad spectrum of sustainability issues and major factors to achieve Sustainable Development Goals.

2. Mapping the field of Sustainable Entrepreneurship and Innovation.

The number of publications on SE and SI is continuously increasing since the beginning of the 2000s (Fig. 1). This trend overlaps with the growth of other important concepts in the innovation field: open innovation and radical (disruptive) innovation. Based on the Schumpeterian theory of "creative destruction," this surge of entrepreneurship and innovation thought was probably unleashed after the burst of the Dotcom bubble and the aftermath recession of 2000-2002. Since that time, the interest in SE and SI experienced almost exponential growth.

Figure 1. Growth of publications on Sustainable Entrepreneurship, Sustainable Innovation, Open Innovation, and Radical Innovation in Web of Science.

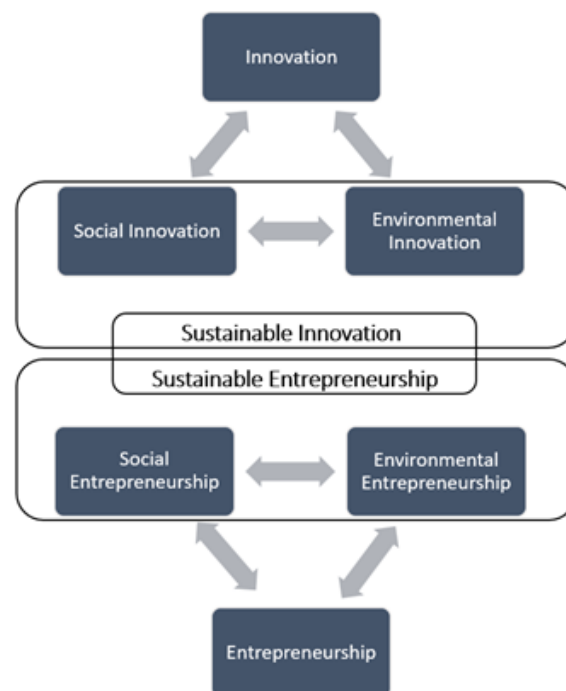
Notes: Search criterion: (sustainable OR social OR eco OR environmental OR green) AND entrepreneurship; (sustainable OR social OR eco OR environmental OR green) AND innovation; "open innovation"; (radical OR disruptive) AND innovation in the title, abstract and keywords 1900 to 2020.



Source: Own Elaboration

The academic literature in the fields of Entrepreneurship and Innovation with a positive impact on society and the Planet is abundant in interchangeable terminologies and overlapping concepts. This makes the research in the area less consistent and slows it down. We use a commonly accepted triple helix framework for Sustainability (Yang et al., 2012) to organize and define SE and SI terms. According to this framework, three major groups of issues currently affect our society: economic, social, and environmental (Purvis et al., 2019). Consequently, entrepreneurship and innovation activities that primarily focus on solving social and environmental challenges are called Sustainable Entrepreneurship and Sustainable Innovation, respectively. In its turn, SE includes Social Entrepreneurship and Environmental Entrepreneurship, and SI includes Social innovation and Environmental Innovation (Watson et al., 2018). The current literature shows that authors also use such synonyms as "Sustainopreneurship" for SE, Ecopreneurship, Green Entrepreneurship, Green Startups, Green Ventures for Environmental Entrepreneurship, and Eco-innovation, Green Innovation for Environmental Innovation. The diversity of terms related to SE and SI is presented in Figure 2.

Figure 2. Diversity of Sustainable Entrepreneurship and Innovation terminology based on the triple helix of sustainability.



Source: Own elaboration.

Sustainable Entrepreneurship can be defined as an active search and creation of sustainable business opportunities that solve a sustainability issue and bring economic benefits (Kirkwood & Walton, 2010). Traditionally, economic literature considers social and environmental issues as "market failures" because free markets do not maximize society's welfare (Bowen et al., 2012). The basic definition of entrepreneurship describes it as an economic activity that uses "market failures," like unmet market needs and underserved markets, as an opportunity to make a profit (Dean & McMullen, 2002). Thus, the potential to solve environmental problems is "built" in the basic definition of entrepreneurship. Therefore, SE is believed to contain a great power to address the major sustainability challenges and promote sustainable green growth, while maintaining competitiveness of firms and bringing economic and social benefits to the stakeholders.

Terminology related to Sustainable Innovation is more complex and confusing for authors and readers. Achterkamp & Vos (2006, p. 526) talk about SI in somewhat blurry and broad terms as the outcome of the innovation process that somehow displays sustainability or innovation that improves sustainability performance of the firm (Boons et al., 2013, p. 2). The more recent studies underline the three-pillar conception of sustainability and define SI as an introduction or adoption of a product, process, organization, or system, which also considers the social, environmental, and economic dimensions of sustainability (Perl-Vorbach et al., 2015, p. 5). The same authors simultaneously use synonym terms in the text: sustainability innovation and sustainability-oriented innovation. Hansen & Große-Dunker (2013, pp. 2407-2408) also treat these terms as synonyms, among several other versions: sustainability-driven innovation, sustainability-related innovation, sustainable development innovation, and sustainability-oriented innovation (SOI) that they define as the commercial introduction of a new (or improved) product (service), product-service system, or pure service which – based on a traceable (qualitative or quantitative) comparative analysis – leads to environmental and/or social benefits over prior version's physical life-cycle.

In most cases, SE and SI co-exist and have a symbiotic relationship. Depending on novelty and complexity, innovations tend to face various barriers that may hinder their implementation. According to the promoters' model, those barriers may be overcome through actors (promoters), who actively and intensively engage with and foster the innovation process. Sustainable entrepreneurs are essential promoters of sustainable development and a driving force for SI (Gerlach, 2003). In its turn, SI proved to be an important factor for sustainable competitive advantage of the firm (Carrillo-Hermosilla et al., 2009), and important tool to deal with the complex and systemic societal challenges,

that require an appropriate mix of novel approaches, ideas, and tools to change the status quo (Bartlett & Trifilova, 2010).

3. Tackling Sustainability Challenges through Open Innovation and Collaboration.

Despite the promising facet of SE and SI, many researchers and practitioners in the field believe that up to this date, these concepts failed to live to the full potential (Ebrahimi & Mirbargkar, 2017). In general, sustainability is very hard in implementations, as it is a complex systemic process that requires restructuring on many levels. Sustainable entrepreneurs experience much more difficulties than bigger well-established firms because they have to deal with common entrepreneurship challenges and setbacks, including the lack of capital, knowledge, and experience. Due to the gravity and time pressure, sustainable development requires more radical and disruptive changes, rather than incremental (Carrillo-Hermosilla et al., 2010; Schaltegger & Wagner, 2011), thus putting additional pressure on the firms. Furthermore, sustainable entrepreneurs also face the classic double externality problem where the value creation of SI is done with the firm's resources, but many times value appropriation happens on the level of society, without direct benefits for the organization (Rennings, 2000). SI happens in domains where social and environmental benefits are common goods, and nobody holds personal responsibility for them. As a result, Sustainable Entrepreneurs many times appeal not to a direct necessity of their clients but their moral values, thus struggling to differentiate themselves from NGO's and volunteering organizations.

One possible solution to overcome SE and SI barriers is Open Innovation and close collaboration with the stakeholders (Cillo et al., 2019). The term 'Open Innovation' (OI) was coined in 2003 by Henry Chesbrough from Haas School of Business and received a steady interest among academics and practitioners since then (Huizingh, 2011). The concept promotes the idea that to survive in today's highly competitive economy, companies need to harness ideas and talents from a broad scope of sources and stakeholders, including employees, customers, and even competitors (Chesbrough, 2003). The popularity of the Open Innovation concept started to grow among researchers and practitioners gradually from 2005 and rapidly developed into a new research field in Innovation and Knowledge Management. Throughout time, it became apparent that OI is a much more complex phenomenon and requires a much deeper understanding and analysis from the point of view of various disciplines, including business, technological, and social aspects. Huizingh (2011) identified several disciplinary approaches to OI, including management, computer science, cognitive science, and even

philosophy. Mattsson & Sørensen (2015) argue that Open Innovation is not just a business concept, but a complex development process in society. In general, the research in the field of Open Innovation is focused on relating the strategy with current business concepts (especially with strategic competitiveness), urgency and significance of collaboration, benefits of OI for the "host" company, types of OI programs, steps of successful collaboration, case studies and benchmarking of best OI practices, struggles of cooperation, and, finally, measuring the success or failure of OI programs (Chesbrough, 2003).

Despite the fast development of the research into different aspects of OI, the primary academic interests are still traditionally focused on the use of OI by the large corporations, while the use of OI by SME's and startups are much less explored (Vanhaverbeke et al., 2012). Nevertheless, a growing body of academic evidence shows the great potential of OI to contribute positively and stimulate entrepreneurial activities in SMEs, and particularly for SE and SI. According to the EC-Europa website, Open Innovation is an ideal feat for Eco-innovative SME's. It happens because OI naturally answers the major challenges and complexities of Eco-innovation. The major benefits of participating and developing new technologies through flexible networks include quick internationalization of new green technologies, sharing the risks and awards for developing new technologies, getting a wide range of feedback, thus quickly improving the new technology and alleviating the burden of innovation investments (Fabrizi et al., 2018). R&D cooperation strategies (De Marchi, 2012), strategic alliances, and joint ventures were proved to increase the innovative capacity of eco-innovative firms (Moro et al., 2019) and contribute to the gain of competitive advantage (Ghisetti et al., 2015)

4. Disruptive Innovations and Radical Change for Sustainability.

Another essential aspect that affects SE and SI's potential to bring the expected and required sustainability benefits is how radical is the change of the current status quo in particular sustainability issues (Kennedy et al., 2017). According to Carrillo-Hermosilla et al. (2009), the sustainable transition requires radical change (rather than incremental change) and system change (rather than "end-of-pipe" and "fast fix" solutions). It is essential to mention that there is nothing inherently wrong with the incremental, accumulative change. However, due to the gravity of social issues and an increasing speed of environmental degradation, our society requires solutions that would bring drastic, positive shifts, deal with the root causes of sustainability challenges (Whiteman et al., 2013).

There exists a critical research gap in academic understanding of the differences between radical and incremental innovations and their relationship with SE and SI (Dangelico, 2016). Nevertheless, we know that R&D of disruptive innovations is a costly endeavor with high uncertainty and risks. The main challenges of radical innovations include the complex knowledge base, convergence of technologies, and commercialization and market diffusion issues. However, if done right, disruptive innovations can catalyze synergies between industries, technologies, institutions, human and economic development, and social trends to provide sustainable, scalable, and resilient solutions for the most pressing global challenges (Dubé et al., 2014).

5. Conclusions.

As a summary of this chapter, we would like to outline several essential tendencies and ideas related to the SE and SI. First, the research on both of these topics is not entirely new for the academic society, and it has been rapidly developing since the beginning of the 2000s. Nevertheless, there are critical research gaps in the literature, including the difficulties defining and mapping the boundaries of SE and SI and finding a universal approach to conceptualize them. It can be explained as a result of a large number of interchangeable terms for almost similar concepts, as well as the multidisciplinary nature of the research in this area (Cillo et al., 2019). Second, despite the theoretically deducted benefits, both SE and SI failed to answer the hopes of many to bring drastic changes to the significant sustainability issues. It happens because both of them are supposed to address multidimensional and systemic issues, however, due to the inherent internal limitations, it ends up being a too challenging task. As a result, SE and SI require access to external knowledge and resources through open innovation strategies and collaboration to overcome those limitations. Finally, the current Grand Challenges of our society require more radical and disruptive changes to catch up with an increasing speed of environmental degradation, Global Warming, social inequality, and other sustainability issues.

Conflict of interests (multiple authors).

(X) The authors declare they have no conflict of interest

Authors' contribution statement.

We, Valery Chistov, Sunita Tanwar and C.S. Yadav, hereby declare that we have all participated in study conceptualization, methodology, study design, and editing. All

authors approve the final version of the manuscript and are responsible for all aspects, including the guarantee of its veracity and integrity.

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