Chapter 10
Towards a Hybrid Framework for Sustainable Innovation

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Abstract This chapter calls for a hybrid sustainable innovation framework. Sections 10.1 and 10.2 present a short introduction to the chapter and a brief account of the growing efforts to arrive at a common understanding of the SI field. This is followed by a discussion on how quantitative approaches could be integrated into CASI-F, as well as how quantitative assessment methods used for product evaluation could be complemented with qualitative approaches similar to those applied in CASI-F. Finally, Sect. 10.4 includes final remarks on multi-stakeholder benefits of systematic SI assessment and management.

10.1 Introduction

Researchers and scholars from around the world have been debating and defining sustainability, sustainable development and sustainable innovation concepts and practices for many decades. There is also an ongoing quest to agree on fundamental SI principles, to map leading and emerging actors in the ever-expanding SI ecosystem and to establish a common SI agenda. This process has triggered a variety of efforts to develop a shared understanding of the SI field. A large variety of approaches to SI assessment and management have also emerged. As discussed in previous chapters, especially in Chap. 1, the CASI-F methodology is primarily built on qualitative approaches to future-oriented impact assessment and management of critical issues potentially shaping or shaking the future of different types of innovations. While

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CASIPEDIA and the piloting of CASI-F showed that there is a demand for the type of action roadmaps produced with such a forward-looking approach, both the innovators and researchers responsible for the development and implementation of CASI-F also recognised the growing appetite for the integration of more quantitative approaches to assess the positive and negative impacts of SI initiatives and suggested roadmaps. By combining qualitative and quantitative approaches it would be possible to arrive at a more universal or hybrid SI framework, which could help reduce the fragmentations and divisions in the growing community of SI practitioners and scholars.

10.2 Towards a Common Understanding of the SI Field

Scholars mapping the field(s) of sustainable innovation (SI) have considered two possible evolutionary pathways: one with highly structured and coherent field and another with a fragmented and dispersed field (Boons and McMeekin 2019). Following extensive reviews of the history of published work, expert opinions, bibliometrics analysis and careful examination of conceptual articles, these authors concluded that the latter pathway is more likely to characterise the future of the SI field(s). Having such an assumption in mind encourages us to seek opportunities within the wider constellation of practitioners, problematics and propositions resulting from the myriad of scientific approaches towards SI. The growing variety of SI visions, practices, priority areas, research methods, stakeholder groups, governance instruments, policy mixes, application domains, as well as assessment and management frameworks should be perceived and understood as an opportunity rather and a threat for the field(s) to evolve.

Let us pause for a while to consider the following metaphor. If someone is really starving, having a large variety of food options may lead to some frustration as to which one to choose from to manage the hunger effectively, enjoyably and safely. However, if someone is able to access food on a regular basis, having a diversity of choices can improve the quality of life and well-being beyond the nutritional dimension. On the contrary, forcing everyone to eat the same “perfect recipe” every day may create imbalances and unexpected challenges, nonetheless because everyone consists of multiple and interconnected systems, which are contextually, culturally, emotionally and genetically diverse. Similarly, researchers and practitioners should not force a “one-size-fits-all” approach towards the understanding of the SI field(s). Furthermore, the authors of the various chapters presented in this book share the common understanding that the SI field(s) will inevitably and increasingly deal with innovations of different types, including social, service, product, governance, organisational, system or marketing. In addition, Sect. 1.3.5 in Chap. 1 shows that CASI-F considered a multi-systemic approach to SI assessment and management involving economic, societal, environmental, infrastructural and governmental systems. With such a large set of criteria related to these systems, it is not surprising to find the resulting CASI-F methodology compatible to practices in other SI-oriented fields, such as Science, Technology and Studies (STS), Ecological Modernization Theory (EMT), Innovation Studies (IS), Social Responsibility

(CSR), Ecological Economics (EE), Industrial Ecology (IE) and Responsible Sustainable Innovation (RSI); and to some extent aligned with other analytical and normative approaches like Constructive Technology Assessment (CTA), Life Cycle Assessment (LCA), Multi-Level Perspectives (MLP), Strategic Niche Management (SNM), Eco-Innovation and Circular Economy (CE), to name a few (see also Ayres and Ayres 2002; Berkhout 2014; Boons and McMeekin 2019; Costanza 1989; Costa et al. 2019; Dunlap 2002; Fischer and Schot 1993; Geels et al. 2015; Guinée et al. 2011; Kemp and Soete 1992; McMeekin and Southerton 2012; Pajula et al. 2017, 2018; Popper et al. 2017; Rip and Belt 1988; Socolow et al. 1994; Spaargaren 2000; York and Rosa 2003).

10.3 Towards a Hybrid SI Framework

The conceptual framework developed in CASI-F for assessing and managing SI is a systematic and comprehensive methodology covering different dimensions of the innovation process and engaging relevant stakeholders. Using mainly qualitative indicators (e.g. anticipated changes in consumption and production patterns, social and individual behaviours, rights of future generations, among others) have helped to develop and implement several action roadmaps; however, the assessment and management of SI practices could also benefit from credible quantitative data. At the same time, quantitative assessment methods used for product evaluation could be complemented with qualitative approaches similar to those applied in CASI-F particularly in terms of societal aspects (see Table 1.2 in Chap. 1).

Sustainability assessment methods to evaluate products have been developed based on quantitative life cycle thinking. Life Cycle Assessment (LCA) is a method to quantify potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw material acquisition through production, use, end-of-life treatment, recycling and final disposal. Life cycle-based thinking enables the minimisation of the overall environmental impacts and the systematically made overview helps to avoid risks of shifting the potential burdens between different life cycle stages or individual processes or between different environmental impacts. The principles, requirements and guidelines to conduct LCA studies are standardised by the International Organization for Standardization (see ISO 14040: 2006 and ISO 14044: 2006) first in 1997 and later revised in 2006. LCA has been successfully used to identify opportunities to improve the environmental performance of products as well as for the purpose of strategic planning, priority setting and product or process design or redesign. The European Commission (2018) has proposed the LCA-based Product Environmental Footprint (PEF) method as a common way of measuring environmental performance. The aim is to achieve a single market for green products in Europe with the help of fact-based and harmonised way of communicating about the environmental impacts of products.

As described above, environmental impacts are typically assessed by measuring and modelling the negative effects that products, services and companies cause to the environment. However, many companies provide or develop technologies, products or services that enable a reduction of environmental impacts of their customers. A need to be capable of quantifying and communicating about the environmental benefits of these products is constantly growing and VTT Technical Research Centre of Finland Ltd. and LUT University have developed an approach for quantifying carbon handprint. This approach gives guidance to quantify positive climate impacts based on standardised LCA and carbon footprint methods. Although the main purpose of the Handprint approach is to enable the communication of the positive impacts, the findings of the project indicate that the handprint quantification approach is useful also to support product development and strategic decisions making (Grönman et al. 2019). The approach is currently being developed further to cover other environmental impacts in addition to climate change.

Sustainability aspects are requested to be addressed in the European Union-funded initiatives developing new products, materials, technologies or business. It is important to reveal potential sustainability implications and provide feedback to the product or concept developers already in the early phase of such initiatives. Therefore, project proposals submitted to the EU are expected to consider accepted (standardised when available) life cycle-based assessment methodologies and indicators, with a clear definition of benchmark and baseline, functional unit, system boundaries, data sources, assumptions, uncertainty and limitations. However, even though sustainability assessment is a mandatory part of most new EU projects, the approach to cover all aspects of sustainability is not yet as established as the environmental assessment. There are a number of initiatives to develop the Life Cycle Sustainability Assessment (LCSA) method and integrate the economic and social aspects to the environmental LCA. Some obstacles that need to be overcome are related to differing approaches behind environmental, economic and social assessments, the applicability of existing social and economic assessment methods and the availability of data (Finkbeiner et al. 2014). The existing methods, tools and databases are often incompatible and require a considerable amount of time and labour resources.

One of the main challenges towards the implementation in LCSA is related to the difficulty of combining multidimensional information under a coherent framework. The integration of multi-domain information represents a great challenge involving complex valuation mechanisms (partly linked to value choices). Decision makers are often confronted with situations where comparisons need to be taken based on contradictory criteria. Additionally, a robust way to conduct this complicated assessment in practice is needed, as well as a way to communicate the results in an informative way to decision makers and interested stakeholders. The CASIPEDIA database, with over 600 SI cases, could be adapted to integrate LCSA approaches into the assessment of positive transformations of economic, societal, environmental, infrastructural and governmental systems; however, such integration would require its own research and innovation agenda.

The transition to a Circular Economy (CE) creates additional challenges for sustainability assessment. The main purpose of the Circular Economy is to develop material/product business models that are economically and environmentally sustainable, with actions supporting each stage of the value chain (from production to consumption, from design to recycling and upcycling of waste materials) while promoting industrial and social innovation. Shifting economic processes from linear to circular business models is part of the solution towards United Nations Sustainability Development Goals (UNSDG). However, not all circular economy solutions are sustainable. Evaluating potential impacts related to circular business models and products requires a comprehensive sustainability assessment methodology that is capable of addressing all these aspects, and highlighting the trade-offs that may take place between the different sustainability domains. Many studies have highlighted that existing methods are not capable of fully addressing the circularity aspects. A quantitative approach needs to be developed that allows assessment of the sustainability multi-criteria trade-offs of circularity (cradle to cradle) dynamically. This is a topic that the European Commission Framework Programme for Research and Innovation will be addressing in the future.

10.4 Final Remarks on Multi-stakeholder Benefits of Systematic SI Assessment and Management

The systematic assessment and management of SI provides unique and shared benefits to multiple stakeholders. This applies to the use of CASI-F as a standalone tool as well as in combination with other sustainability assessment methods and frameworks. The versatility of the approach makes it accessible to a variety of actors, applicable to different areas of science and industry, and capable of delivering results needed to more effectively address and meet current challenges. SI actors can benefit from the approach through learning by doing or learning from the experience of others, both of which can provide valuable future-oriented insights and lessons. More specifically, policymakers, when aiming to design and implement future-proof SI policies, could explore SI practices to identify policy gaps, new research priorities for SI agendas and multi-perspective critical issues affecting the SI landscape:

- *Government actors* would benefit from a better understanding of the hopes, fears and expectations of societal actors that can be elicited through the application of such approaches.
- *Business actors* can use CASIPEDIA to search for approaches that add value to their short- and long-term activities and development plans. The most prominent benefits, confirmed through a pilot study with innovators, include the possibility of identifying and taking advantage of potential drivers and opportunities, as well as building resilience and overcoming likely threats and barriers by defining SI strategies and reinforcing management decisions through the implementation of

actions and meta-actions and the development of future-oriented action roadmaps.

- *Civil Society actors* can use the wealth of information gathered through mapping activities to increase awareness of emerging research and innovation priorities and agendas, identify management aspects that require public engagement, as well as discover new grassroots initiatives, services and products that are socially oriented and participate as appropriate.
- Finally, *Research and Education actors* are increasingly using CASI-F and CASIPEDIA to point out to future research avenues and gaps, emergent research priorities and urgent issues. It has been demonstrated, on several occasions, that the approach can support lectures, training courses, a wide range of research activities, the development of new SI databases and statistics, and drive research careers through advice linked to management actions.

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