Sustainability and Innovation

Mattia Martini
Rick Hölsgens
Rafael Popper *Editors*

Governance and Management of Sustainable Innovation

Learning from Experience to Shape the Future

Springer

Sustainability and Innovation

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Foreword

There was a man in our town and he was wondrous wise,
He jumped into a bramble bush—and scratched out both his eyes;
And when he found what he had done, with all his might and main
He jumped into the bramble bush—and scratched them in again.

Old English Nursery Rhyme, origins uncertain

I have been quoting this rhyme for some decades; I find that it resonates with several important aspects of our social and ecological predicament, our civilisational dilemma. It suggests that sometimes the solution to a problem may be, at least in part, a matter of repeating the very behaviour that has caused the problem. Repeating precisely the same behaviour may very well intensify the problem, of course. But sometimes a revision of the behaviour, informed by an understanding of how the problem was caused in the first place, can help to address the problem, if not completely restore matters to their earlier state. This book, *Governance and Management of Sustainable Innovation*, contributes to this mission.

Over two centuries, more and more of the (growing) human population has been drawn into industrial ways of life. Whether we work in the classic industrial sectors or are mainly users of the products of these sectors, our patterns of production and consumption have been, and are still being, transformed through the application of technological and organisational innovations. This 'bramble bush' can be seen as scratching out our eyes in two senses. First, we can see our jumping into the process of transformation without much vision of, or concern for, the enormous impacts that we would be having on the natural world. The environmental regulation of business and household activity has a long history, though in general the focus was on preventing a local nuisance. The world was assumed to be so vast that our consumption and destruction of resources (including depletion of geological resources, pollution of water, land and air, and loss of biodiversity) was rarely thought of as a global or even national problem. Jevons' *The Coal Question*, written in the middle of the nineteenth century (published 1865), did warn of catastrophic effect that the exhaustion of coal mines would have. But continuing exploitation of coal, and the realisation that other fossil fuels could be even more effective sources of power,

seemed evidence of almost limitless natural resources. It would be another century before concerns about *The Limits to Growth* (published 1972) regained a place on the agenda, and even that has been highly contested over much of the last half-century.

The second interpretation of the nursery rhyme stems from our growing awareness that the assumption that we could ignore environmental 'externalities', as if we lived in a limitless world, was wrong. Now it is not our eyes that are being scratched out—if anything we have gained more clarity in our vision. It is human civilisation itself that is threatened with being scratched out, by the growing climate emergency (let alone numerous other challenges to our food, health, and water securities). We have a clearer view of the risks associated with persisting with current modes of production and consumption—global heating and its consequences for agriculture, sea levels, and many ecosystems services. Additionally, there are many uncertainties associated with possible 'tipping points' that might trigger collapses and possibly set off chains of highly negative wild card events. We cannot reliably estimate the likelihoods of such events, but we do know enough to warrant a good deal of caution.

Yet we cannot simply abandon our knowledge and revert to preindustrial ways of life. The global population is at levels far above those that preindustrial economies could support. It would be disastrous to relinquish many of our technological and organisational innovations, even if we can envisage ways in which they can be improved. The argument that underpins the present volume, and the efforts of a growing number of activists and researchers—and business leaders and policymakers—around the world, is not that we should abandon innovation and focus on reducing demand and living 'simpler' lives. Apart from anything else, even if enough of the public were prepared to make the necessary changes, there is limited scope for cutting living standards in poorer parts of the world—and less equity in this.

The argument that is gaining traction now is that innovation has to be moved onto a new trajectory. This is more than just hoping for 'tech fixes', breakthroughs that could solve problems of the underavailability of energy and the overproduction of greenhouse gases in a flash. There are ways of confronting problems with, for example, large-scale roll-out of renewable energy systems and tree planting initiatives (though many of these require both time and extensive organisational change), but these are not 'fixes' that will make problems go away. Changes in innovation policies, strategies, and institutional frameworks ('innovation ecosystems') are required to establish new trajectories for technological and organisational change. These trajectories are ones that point in much more sustainable directions, where environmental criteria are built into decisions about new ways of doing things. In terms of the nursery rhyme metaphor, we need a new vision for the bramble bush. Otherwise, there is no way that future generations will view us as being 'wondrous wise'. The wonder will be that our knowledge was applied so blindly: *There was a man in our town, he was a wondrous fool.*

The authors represented in *Governance and Management of Sustainable Innovation* do not claim unique wisdom, nor to have all the answers. Indeed, that is a

strength of their contributions, for several reasons. It is an invitation to further development of the ideas, to further exploration and innovation from activists, researchers, and practitioners of all kinds. It recognises the need for numerous initiatives to be taken, on many scales, with many engaged constituents. And it avoids the trap of assuming that change can be smooth and linear, whereas in practice it is often bumpy and winding. It is not like plunging into a bramble bush—it is more like trying to find a way through a forest. It is practically inevitable that major initiatives will have unintended consequences, and while some of these may be synergistic and reinforce and embed desired impacts, some are quite likely to subvert these goals. This is one factor behind the disappointment frequently associated with scaling up of innovations, when something that seemed so promising as a pilot or small-scale initiative turns out to be far less effective when implemented on a larger scale. One of the contributions of this book is to point us towards the need to monitor innovative efforts and towards ways of assessing their contributions to achieving sustainable ways of life.

Governance and Management of Sustainable Innovation thus addresses critical questions. What is sustainable innovation? What are the innovation processes that can support the transition to more sustainable modes of production and consumption, and how are various actors, institutions, and practices involved? What are the resulting innovations, and how can we assess their contributions? What policies and strategies are involved, how are they implemented with respect to different types of innovation, and how are different constituencies involved in the co-creation of new routines? How can stakeholders (and their knowledge) be mobilised, and what can the role be of future-oriented narratives in establishing more alignment of action and visions across communities?

These are far more than academic questions, even though we sometimes need to employ elaborate methods of analysis to address them. (Despite the claims that we have entered a 'post-truth' era, expertise is required, including expert understanding of social and organisational affairs as well as deep knowledge of engineering, ecology, and the like.) Translating the messages that arise from these analyses is vital. This is bound to be a matter of practical engagement in particular concrete instances, when the relevance of the concepts and assessments becomes starkly clear. In effect, this means not just painting a picture of the bramble bush, or vividly warning about thorns. It involves demonstrating what it involves to re-enter the bramble bush with eyes wide open—what tools may be needed to avoid getting cut, entangled, and blinded.

The bramble bush is an imperfect metaphor, especially because it concerns a single man, and we are addressing problems that involve collaborative action and social innovation. Songs and rhymes are sometimes used to coordinate collective action. One nursery rhyme is rather ominous in this respect—'a-tishoo, a-tishoo, we all fall down' is redolent of collective catastrophe and is generally supposed to refer to one of the plagues that struck medieval Europe. Work songs, such as sea shanties, accompany and sometimes synchronise (and add some fun to?) activities. The success of innovations may require their routines to be socially and aesthetically rewarding, though collective songs may not be in order. What will be of value are

narratives that can tell us about the process of creating constituencies around both the processes of creating sustainable innovation and the ongoing implementation and elaboration of such innovations. These narratives are much more like stories than simple rhymes. They may involve both case studies of actual experiences and scenarios explicating life within possible sustainable futures. They may be tailored to different audiences—and indeed, these, too, can be co-created with their 'users'.

To summarise: a sustainable future requires sustainable innovation; action for sustainable innovation requires sustainable narratives of how and why such innovation is created and co-created. *Governance and Management of Sustainable Innovation* provides necessary parts of the foundation for such narratives and the action that they inform.

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Preface

Innovation is a key driver of societal progress in industrialised economies, especially in the management of imminent changes and uncertainties shaping the present and the future. In order to address the grand societal challenges of climate change, resource availability and environmental pollution, sustainability should be the focal point of the innovation process. Focusing innovative efforts towards sustainability goals, however, is still far from common practice as the concept of innovation tends to be surmounted with the notion of economic progress and the growth of welfare, rather than societal well-being.

Sustainable Innovation (SI) is defined as "*any incremental or radical change in a socio-technical system that leads to positive environmental, economic and social transformations without compromising the needs, welfare and wellbeing of current and future generations"* (Popper et al., 2016, see also Chap. 1). Given its multidimensional nature, SI involves different actors and interests; consequently, the active engagement of multiple stakeholders represents one of the main critical issues for the purpose of managing sustainable innovation. This is also true in the case of the formulation of SI-related policies and programmes, in which public participation, including citizens and civil society organisations, improves both the democratic legitimacy as well as the impacts realised through the implementation of these policies. Due to the complexity and ambiguity of sustainable development, the need for, and the interest in, developing evidence and knowledge about the management and governance of sustainable innovations and SI-related policies become apparent.

The book "*Governance and Management of Sustainable Innovation: Learning from Experience to Shape the Future*" is intended to contribute to this debate by sharing the results of a thorough desk and action research produced during the implementation of the European Union (EU) project "Public Participation in Developing a Common Framework for the Assessment and Management of Sustainable Innovation" (known by its short name: CASI), which was funded through the Seventh Framework Programme (grant agreement number 612113).

The CASI project was proposed as a response to one of the seven grand societal challenges set out in the Horizon 2020 programme of the European Union, namely "*Climate action, environment, resource efficiency and raw materials*" (known in EU circles as Societal Challenge 5 or SC5). It represented an EU-wide cross-sectoral partnership on innovation-related issues and considered not only the impacts of social and technological innovation but also other types, as well as the roles and interests of actors involved in the innovation process. A key ambition of the project was to develop a coherent methodology for the assessment and management of sustainable innovation practices, based on a sound conceptual framework and a shared understanding of sustainability in innovation, among a wide range of stakeholders (see also the project description on the CASI website, and Chap. 1 by Popper et al.).

Through a process of mapping sustainable innovations across Europe, practices representing unique social and technological innovations have been considered to study specific factors of, as well as consequences for, sustainability challenges with regards to social and business-oriented challenges. The CASI project provided opportunities and various entrance points for stakeholders to participate in debates on sustainable innovation, as well as on policy developments that ensured opportunities for a continuous and systematic assessment and management of SI initiatives.

CASI emphasised and enabled multi-stakeholders dialogue and participation by relying on highly participatory methods of citizen engagement (see especially Chap. 5 by Repo et al.). Based on citizen's input and results from CASI's internal analyses, EU-wide policy recommendations have been developed with the ambition to improve the integration of sustainability and innovation support actions for addressing the underlying issues embedded into Societal Challenge 5.[1]

The 19-partner consortium of the CASI project covered 12 EU Member States, while some additional 16 EU countries were represented by an extended network of national correspondents or experts who provided relevant inputs to the project.

Building on the work carried out during the CASI project and the multidisciplinary background of its contributors, this book aims to provide evidence, insights and reflection related to specific issues of governance and management of SI, which are addressed through the application of a common framework, using a multilevel and multi-stakeholder approach to sustainable innovation analysis. The CASI Framework (known as CASI-F) is used for the assessment and management of sustainability-oriented innovations, policies and aspirations of citizens. The Framework was developed with empirical evidence from an extensive, comprehensive and highly inductive study of more than 500 SI initiatives and lessons learned from stakeholders' mobilisation and mutual learning activities.

The idea of this book comes from the growing need to compile, analyse and add value to the lessons learned from the development and implementation of the conceptual and methodological framework (CASI-F). A valuable contribution to the knowledge of this book is the way the authors build on selected empirical studies

[1] See http://www.futuresdiamond.com/casi2020/about/description/

that originated from CASI-F applications in order to provide a systematic and interconnected set of approaches, insights and lessons, which complement and enrich the academic literature in the field of sustainability, as well as SI assessment and management. Overall, the results of the empirical studies were supported by a systematic use of foresight and forward-looking action research combining evidence, expertise, interaction and creativity-based approaches.

Compared to previous efforts to explore SI concepts, this contribution proposes a more methodological and practical approach, by focusing on why and how the quadruple helix of SI actors (i.e. government, business, civil society and research and education stakeholders as the main players in the innovation process), are increasingly involved in the assessment and management of sustainable innovation. Furthermore, the CASI-F driven mobilisation and mutual learning (MML) process helped to promote the incorporation of science in society by integrating multiple sources of knowledge and including multi-stakeholder perspectives (including citizens and sustainability experts) into the assessment of critical issues, and by advancing and incorporating scientific knowledge and innovative ideas from practice, and vice versa; thus enhancing the management of sustainable innovations that embraces societal concerns and needs.

This collective book is composed of ten chapters and structured around three main parts.

The first part focuses on the presentation of the conceptual framework and the theoretical context of SI, which provides a foundation for the remaining parts, and serves as a tangible illustration of how the empirical data was collected through the application of the CASI-F methodological framework.

Rafael Popper, Monika Popper and *Guillermo Velasco's* chapter sets the scene for the book by introducing the CASI Framework—a systematic five-step approach for the assessment and management of sustainable innovation (CASI-F)—the key components of which are used throughout the book. The authors also present working definitions of SI and lay out basic principles of multilevel perspectives and transitions, mobilisation and mutual learning, as well as multi-systemic assessment and management, all of which are further explored in the subsequent chapters. The chapter describes the final CASI-F methodology and associated protocols and tools (i.e. platform) while demonstrating the need for such an approach and the framing rationales and drivers that led to the development of the Framework. The chapter also offers a rich set of practical managerial lessons resulting from the empirical application of CASI-F, followed by an overview of CASI-F applications and its possible evolution. It concludes with some reflections on the authors' approach to learn from experience to shape the future.

Aleš Lipnik and *Maja Cergol Lipnik*'s chapter explores the topic of SI by offering a "panoramic overview". It provides newcomers with relevant information about (sustainable) innovation and related concepts. The chapter also aims to help the reader become familiar with major SI priorities at both European and global levels (e.g. by listing the United Nations Sustainable Development Goals). This is presented through a review of the mainstream literature on the definitions of

innovations with a specific focus on SI, and overviewing the development of the concept of eco-innovation into the CASI definition of sustainable innovation.

Part I concludes with a chapter by *Rick Hölsgens* and *Jürgen Schultze* introducing the seven types of sustainable innovation that have been mapped and studied within the CASI project. The chapter then focuses on the role of social innovations for sustainability. Building on examples from CASI and beyond, the authors demonstrate the importance of social innovations for the transition towards sustainability from the following two angles: (1) by altering social practices; and (2) by introducing novel ways of working and of collaborating. In their latter role, socially innovative initiatives can contribute to the transition to sustainability by promoting new methods for co-creation and consensus-based innovation, and new approaches to planning and policymaking that can lead to more sustainable products, practices and services.

The second part of the book focuses on the participatory governance of SI as it highlights SI-related priorities and the role of public engagement in forthcoming SI activities. In addition to the evidence-based analysis, innovative methodologies for policymakers emerged from the mapping of SI policies at the EU, national and local levels, as well as from the visions of citizens about sustainable futures.

Mattia Martini, Elisabetta Marafioti and *Monica Carminat*'s chapter explores how different configurations of stakeholder engagement influence the generation of sustainable innovations. By assessing a sample of agro-food Italian companies, the study identifies different SI strategies and explores the role of cultural and managerial attributes related to stakeholder engagement in supporting the development of SI strategies.

The chapter by *Petteri Repo, Kaisa Matschoss, Bjørn Bedsted, Zoya Damianova* and *Ventseslav Kozarev* identifies shared and specific topics in visions on sustainable futures, which were co-authored by citizens in connection to CASI and other two European projects (CIVISTI and CIMULACT). The chapter, in particular, reviews how European citizens envision desirable and sustainable futures by analysing a total of 298 visions. The authors identify how people's agendas for sustainable futures are expressed in the examined visions and reveal 20 identified agendas. The chapter further examines how the citizens' priorities relate to sustainable innovation.

Part II concludes with a chapter by *Benedetta Trivellato, Monica Carminati* and *Mattia Martini* that looks into a case of sustainable innovation implemented by the public sector to provide a better understanding of the dynamics, which allow the innovative process to benefit from stakeholders' contribution. The study shows that sustainable innovation in the public context may be seen as the result of a stakeholder co-creation process involving the main innovation promoter and its internal and external stakeholders. Both types of stakeholders are found to be involved in a collaboration process that fosters knowledge mobilisation and, in turn, is reinforced and fuelled by it.

The third part of the book investigates lessons learned from the management of SI, drawing attention to SI-related critical issues (barriers, drivers, opportunities and threats), management actions, dimensions and key aspects linked to the most relevant phases of the innovation process. The contributions for an effective

management of SI come from the comparison and assessment of SI cases, starting from those mapped and stored in the CASIPEDIA platform (i.e. a web-based set of protocols and tools supporting CASI-F application to SI initiatives).

The chapter by *Laura Mariani, Dario Cavenago* and *Elisabetta Marafioti* explores grassroots sustainable innovations as novel and sustainable solutions designed and developed by the actors of civil society in order to respond to local issues. By focusing on three case studies of food banks across Europe, their chapter assesses SI business models so as to identify drivers that can support and favour the diffusion of such initiatives, in order to reduce the problem of food surplus in European countries.

The chapter by *Rick Hölsgens* explores the importance of addressing both the innovator and the adopters when trying to grasps the dynamics of sustainable social innovation diffusion. The author concludes that by asking why, rather than how, sustainable social innovations diffuse, it becomes evident that the acceptance of sustainable social innovations cannot be taken for granted. Both innovators and adopters need to be motivated to actively diffuse social innovation and they need to have the capacity to do so.

Guillermo Velasco, Monika Popper and *Rafael Popper* take a closer look at lessons learned from the analysis of 1700+ "critical issues" emerging from the assessment of 200+ SI initiatives in Europe and the world. The critical issues were mapped against technological, economic, environmental, political, social, ethical and spatial perspectives, and their analysis allows the authors to draw 60 managerial messages. The key considerations and lessons for SI management are related to important, feasible and impactful actions, which selected innovators prioritised to solve SI critical issues and support the development and success of this kind of an initiative.[2]

Finally, *Tiina Pajula* and *Rafael Popper* reflect on the growing need to reduce fragmentation of SI community of practitioners and scholars through a hybrid

[2]The readers should also note that given the nature and weight of the conceptual, methodological and managerial implications of CASI-F in the CASI project and this book, it was decided by the Editors that Chap.1 and Chap. 9 would collect and summarise important findings previously published by the authors in several reports for the European Commission (which are cited accordingly); however, the chapters still provide new perspectives and substantial amount of new insights and lessons.

- Popper, R., Velasco, G., and Popper, M. (2017). CASI-F: Common Framework for the Assessment and Management of Sustainable Innovation, CASI project report to the European Commission. Deliverable 6.2.
- Popper, R. and Velasco, G. (Eds.) (2017). Sustainable Innovation Policy Advice. CASI Project report. Deliverable 7.2, European Commission.
- Popper, R., Velasco, G. and Ravetz, J. (2016) *State-of-the-art of Sustainable Innovation: Climate action, environment, resource efficiency and raw materials*. CASI Project report to the European Commission. Deliverable 2.1.
- Popper, R., Velasco, G., Bleda, M., Amanatidou, E., Ravetz, J., Damianova, Z., Kozarev, V., Chonkova B., Tsin, S., Avarello, A., Martin, L. and Morris, D. (2016). "Sustainable Innovation Conceptual Framework", CASI Project report to the European Commission. Deliverable 2.2.

framework for SI assessment and management that combines the qualitative and forward-looking approaches used in CASI-F with quantitative methods such as Lice Cycle Sustainability Assessment (LCSA).

The time seems ripe to investigate the somehow ambiguous aspects of sustainable innovation. This book offers its readers a myriad of insights, practical examples, protocols and tools to explore the more indefinable characteristics of SI. The collection of chapters aims to shed light on a number of important modern-day issues related to *Governance and Management of Sustainable Innovation*, which may be of interest to researchers, practitioners and decision makers alike, who are alarmed about the sustainability of our future. As observed by Ian Miles in the *Foreword*, this book is "*an invitation to further development of the ideas, to further exploration and innovation from activists, researchers, and practitioners of all kinds. It recognises the need for numerous initiatives to be taken, on many scales, with many engaged constituents. And it avoids the trap of assuming that change can be smooth and linear, whereas in practice it is often bumpy and winding*".

Milan, Italy — Mattia Martini
Dortmund, Germany — Rick Hölsgens
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Contents

Part III Management of Sustainable Innovation

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Rick Hölsgens (PhD) works as social scientist at TU Dortmund University (Social Research Center) on topics at the crossroads of social innovation and sustainability research. He has a bachelor's degree in industrial design from Eindhoven University of Technology and master's degrees (MA and MSc) in science and technology studies from Maastricht University. In 2016, he obtained his PhD from Groningen University in the area of economic history (dissertation title: Energy Transitions in the Netherlands: Sustainability Challenges in a Historical and Comparative Perspective). His main research interests are sustainability transitions and social innovation, both from a contemporary and historical perspective.

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List of Abbreviations and Acronyms

AMAT	Agency for Mobility, Environment and Land
ATM	Milanese Public Transports
BEPA	Bureau of European Policy Advisors
B2B	Business To Business
B2C	Business To Consumers
CASI	Public Participation in Developing a Common Framework for the Assessment and Management of Sustainable Innovation
CASI-F	Common Framework for the Assessment and Management of Sustainable Innovation
CE	Eco-Innovation and Circular Economy
CIMULACT	Citizen and Multi-Actor Consultation on Horizon 2020
CIVISTI	Citizen Visions on Science, Technology and Innovation
COTEC	Italian National Foundation for Technological Innovation
CSR	Corporate Social Responsibility
CTA	Constructive Technology Assessment
EC	European Commission
EE	Ecological Economics
EMT	Ecological Modernization Theory
EU	European Union
EFB	Estonian Food Bank
FAO	Food and Agriculture Organization of the United Nations
FBA	Fondazione Banco Alimentare
GDP	Gross Domestic Product
ICT	Information and Communication Technology
IE	Industrial Ecology
IPCC	Intergovernmental Panel on Climate Change
IPR	Intellectual Property Rights
IS	Innovation Studies
ISIC	International Standard Industrial Classification

ISO	Quality Management Standard
LCA	Life Cycle Assessment
LCSA	Life Cycle Sustainability Assessment
LDA	Latent Dirichlet Allocation
MLP	Multi-Level Perspective
MML	Mobilisation and Mutual Learning
NGO	Non-Governmental Organisation
NIS	National Innovation System
NPO	No Profit Organization
OECD	Organization for Economic Co-operation and Development
PEF	Product Environmental Footprint
PR	Public Relations
R&I	Research and Innovation
RSI	Responsible Sustainable Innovation
RTDI	Research, Technology Development and Innovation
SC5	Societal Challenge 5
SDGs	Sustainable Development Goals
SI	Sustainable Innovation
SI-Drive	Battery Technology to Drive Electric Vehicles of the Future
SIMG	Italian Society of General Medicine
SME	Small and Medium Enterprise
SNM	Strategic Niche Management
SOI	Sustainability-Oriented Innovation
STS	Science, Technology and Studies
TEEPSES	Technological, Economic, Environmental, Political, Social, Ethical and Spatial
TRANSIT	Transformative Social Innovation Theory
UN	United Nations
WT	Wiener Tafel
WWII	Second World War

Part I
Conceptual Framework and Empirical Context

Chapter 1
Sustainable Innovation Assessment and Management Framework: Principles, Methodology and Practice

Rafael Popper, Monika Popper, and Guillermo Velasco

No book can ever be finished. While working on it we learn just enough to find it immature the moment we turn away from it.

Karl Popper (1945).

Abstract This chapter introduces a methodology and a set of interconnected tools (i.e. platform) for the assessment and management of sustainable innovation, known as CASI-F or CASI Framework. Sections 1.1, 1.2, 1.3 offer a big picture overview of CASI-F rationales, genesis and principles. Then the five-step CASI-F methodology is thoroughly presented in Sect. 1.4 with dedicated subsections describing the methodological protocols and supporting tools in CASIPEDIA. Section 1.5 shows some highlights from the evaluation of CASI-F implementation in 43 pilots, which also helped the authors derive some 150 managerial lessons clustered around 10 key aspects. Sections 1.6 and 1.7 provide an overview of CASI-F applications and its possible evolution. Finally, Sect. 1.8 concludes with some reflections on our approach to 'learning from experience to shape the future'.

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1.1 CASI-F Rationales: Co-assessing and Co-managing Sustainable Innovation (SI)

The EU funded CASI project on 'Public Participation in Developing a Common Framework for the Assessment and Management of Sustainable Innovation (SI)' emerged in response to the grand societal challenge on 'Climate action, environment, resource efficiency and raw materials'. CASI was successfully completed in 2017; however, the efforts to apply CASI-F are far from over. Therefore, while we have finished this chapter and the book, readers should note that the authors are still maturing, refining and further developing CASI-F, based on lessons learned from several post-CASI project applications and adaptations to the needs of science, technology and innovation policy actors (see Sect. 3.6).

Addressing extremely complex in nature societal challenges requires collaboration of multiple stakeholders. With this in mind, CASI-F was co-developed and piloted with an active mobilisation and mutual learning approach that engaged the quadruple helix actors of sustainable innovation, representing government, business, research/education and civil society. Overall, the main result of CASI-F is a 'knowledge co-creation, co-assessment and co-management methodology and platform', supporting the sustainability of a wide range of innovations. In order to effectively and systematically pilot and communicate the Framework with multiple stakeholders, it was necessary to develop the following working definition for 'Sustainable Innovation' and, later, a more comprehensive definition for 'Responsible Sustainable Innovation'.

Sustainable Innovation (SI) is any incremental or radical change in the social, service, product, governance, organisational, system or marketing landscape that leads to positive environmental, economic and social transformation without compromising the needs, welfare and wellbeing of current and future generations (Popper et al. 2016a, 2017b).

Responsible Sustainable Innovation (RSI) is the result of a smart quadruple helix (S4H) oriented effort supporting the incremental or radical evolution of a socio-technical system based on positive multi-systemic transitions or transformations without compromising the needs, welfare and wellbeing of current and future generations. By multi-systemic transformations we mean environmental, economic, social, government and infrastructure systems while the S4H effort refers to a carefully planned and timely implemented mobilisation and mutual learning process engaging government, business, civil society and research and education stakeholders (Popper et al. 2017c).

The development of SI working definitions and the Framework was also informed by insights from a multi-stakeholder survey gathering more than 1300 responses, predominantly from Europe (98%) and with half of respondents having completed postgraduate studies, 401 at Master's level and 246 at Doctoral level,

Table 1.1 Roles of key stakeholders in 202 SI case studies

Roles of key stakeholders	Innovators	Sponsors	Brokers	Users
Finance	•••	••••	•	•
Developing	••••	•	•••	•••
Dissemination and communication	•••	•	••••	••••
Diffusing	•••	•	•••	••••
Testing/piloting	•••	•	••	••••
Endorsing	•	•••	•••	•••
Capacity building and training	•••	•	•••	••
Designing	••••	•	•	•
Representing interests	••	•	••	•••
Commercialising	••	•	••	••
Technology transfer	••	•	••	•
Complementing	•	•	••	••
Networks and data provision	•	•	••	•
Influencing/lobbying	•	•	•	•
Supplying	•	•	••	•

Note: Negligible to Low [•], Medium [••], High [•••], Very high [••••]
Source: authors' elaboration

covering the following fields: Social sciences, journalism and information (27%); Engineering, manufacturing and construction (24%); Business administration and law (23%); Natural sciences, mathematics and statistics (20%); Agriculture, forestry, fisheries and veterinary (7%); Information and communication technologies (6%); Arts and Humanities (6%); Education (4%); Health and welfare (3%); Services (2%); and Other (10%). The views of these 647 multidisciplinary experts confirmed, with 85% consensus, that the main characteristic of SI is that it simultaneously integrates environmental, social and financial considerations into 'innovation processes'. The consolidation of the 'open innovation paradigm' (Chesbrough 2003) and the multiple roles of stakeholders in driving innovation (see Rigby et al. 2013 and Table 1.1 below) were also considered when prioritising innovation processes.

To do so, the same group of 647 experts were asked to indicate the top two out of the following seven innovation categories that are most favourable to SI (see Popper et al. 2016a, b).

Product innovation refers to the introduction of a good that is new or significantly improved with respect to its characteristics or intended uses (OECD 2005), e.g. scientific advances with innovation potential, industrial innovations with deployment potential, and new products on the market with sustainability potential.

Service innovation refers to the introduction of a service that is new or significantly improved with respect to its characteristics or intended uses,

(continued)

e.g. efficiency or speed improvements, new functions or characteristics of existing services, or entirely new services (OECD 2005).

Social innovation refers to new society-driven solutions that simultaneously meet a social need and lead to new or improved capabilities and relationships and better use of assets and resources. In other words, social innovations are both good for society and enhance society's capacity to act (see Caulier-Grice et al. 2012).

Organisational innovation refers to the implementation of a new method in business practices, workplace organisation or external relations to increase performance by reducing administrative costs or transaction costs, improving workplace satisfaction and labour productivity, gaining access to non-tradable assets (e.g. non-codified external knowledge) or reducing costs of supplies (OECD 2005). This includes new financial, infrastructure and business models.

Governance innovation refers to new forms of citizen engagement, new democratic institutions, new public and user participation in service design and delivery, and the use of public boards to govern particular choices. It includes new political arrangements in local and national governments as well as changes in the organisational form and arrangements for the planning and delivery of public services (Hartley 2005).

System innovation refers to a set of interconnected innovations, where each is dependent on the other, with innovation both in the parts of the system and in the ways that they interact (Caulier-Grice et al. 2012). This normally involves a complex interaction of public policy and reforms to legislation, changes to business cultures and practices, as well as shifts in consumer attitudes and behaviour. It is also about large-scale transformations in the way societal functions are fulfilled (Geels 2004a).

Marketing innovation refers to the implementation of a new marketing method involving significant changes in product or service design or packaging, placement, promotion or pricing (OECD 2005). Sustainable marketing innovations are aimed at better positioning the social, economic and environmental benefits of new/improved products, services and processes.

Product innovation (48%) and *System* innovation (43%) were clearly prioritised; however, the following four categories were also viewed as significantly important for sustainability: *Social* innovation (30%), *Service* innovation (30%), *Organisational* innovation (22%) and *Governance* innovations (22%). Although *Marketing* innovation was only prioritised by 3% of the experts, the authors and the CASI project partners agreed to undertake a truly comprehensive and holistic approach to the development of the Framework, which resulted in CASI-F being conceived and piloted to assess and manage all types of innovation.

The decision to develop a Framework capable of supporting multiple types of innovations, especially in priority areas related to 'climate action, environment,

resource efficiency and raw materials', encouraged the authors to look into classic efforts to promote strategic management with high levels of environmental turbulence and change. Freeman's (1984) 'stakeholder approach' was an obvious starting point to ensure that CASI-F considered 'stakeholders' as 'any group or individual who is affected by or can affect the achievement of an organization's objective'. In so doing, one of the challenges we faced, as Freeman and McVea (2001) would argue, was to find 'new ways of describing excellent ways of creating value' so as 'to provide hope and stimulate change and innovation'. Furthermore, we anticipated that the real expected value of the CASI-F was its ability to help innovators recognise and undertake practical multilevel actions rather than its theoretical sophistication. It is for this reason that careful attention was paid into the agreement that those 647 experts showed around what a sustainable innovation assessment and management framework should focus on. Regarding sustainable innovation assessment: 78% of experts agreed its results should be used to design better management systems in the company; 64% agreed that it should be concerned with defining the business relevance of an innovation; 63% agreed that it is only possible if there are predefined sustainability-oriented goals; and 62% agreed that it should be concerned with defining the policy relevance of an innovation. With regards to sustainable innovation management: 90% of experts agreed that it refers to integrating sustainability in the entire innovation value chain; 83% agreed that it is concerned with positioning sustainability within a company's strategic plans; 79% agreed that it is greatly concerned with a demonstrated positive environmental impact resulting from an innovation's diffusion over time; 71% agreed that it is concerned with attaining objectives beyond business/profit ones; 68% agreed that it is part of corporate social responsibility strategies; and 67% agreed that it is addressing sustainability-related challenges through normal business operations.

The above set of multi-stakeholder agreements on rationales for CASI-F is fully aligned with the prime objective of the CASI project to develop a Framework that promotes mutual learning from state-of-the-art assessment and management of SI experiences, with the aim to shape the future of sustainable innovations through the active mobilisation and engagement of the quadruple helix of SI actors in the co-creation of shared visions and action roadmaps supporting research, technology development and innovation (RTDI) activities addressing the grand societal challenge on 'climate action, environment, resource efficiency and raw materials'.

1.2 CASI-F Genesis: Mobilisation and Mutual Learning for Societal Challenges and SI

The CASI project was funded by the European Commission's Science in Society Programme of the 7th Framework Programme for Research and Innovation of the European Commission, within the theme of 'Mobilisation and Mutual Learning (MML) Action Plans: mainstreaming Science in Society (SiS) actions in Research'.

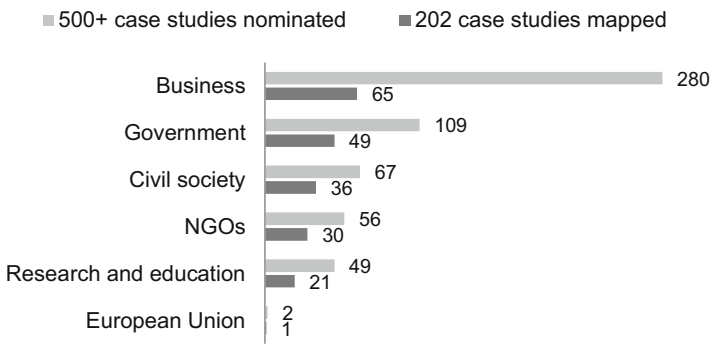

Fig. 1.1 Leading type of stakeholders mobilised in CASI case studies. Source: authors' elaboration

The theme and nature of the project allowed the continuous elaboration of CASI-F while it was being co-created through action research, including 548 case studies of sustainable innovations led by business, government, civil society, non-governmental organisations (NGOs), research and education and the EU (see Fig. 1.1), as well as over 40 pilots, dozens of workshops, some 24 citizen panels, and other inductive and participatory approaches.

The main focus of CASI's EU-wide cross-sectoral partnership, which mobilised 19 partners from 12 EU countries, country correspondents from 16 other EU Member States, and a network of stakeholders from across the EU, was on innovation-related challenges and the multi-stakeholder collaboration opportunities that could improve the sustainability of innovations. Building bridges between a wide range of stakeholders allowed to look into the scope of SI as a societal phenomenon and facilitated the elaboration of CASI-F based on a common understanding of SI processes. Varied knowledge crowd-sourcing strategies were developed and enabled by web-based tools integrated into a working platform called CASIPEDIA. While CASI-F promotes a structured process supported by five sets of tools and protocols, it is at the same time flexible and versatile enough to stimulate open reflections and challenge users with divergent thinking, which is absolutely necessary to address complex societal challenges.

CASI-F's mobilisation and mutual learning strategy took into account that '*successful innovation depends on maintaining a strong user perspective over time; this argues for mechanisms which emphasize continuing interaction rather than a one-off information gathering exercise*' (Tidd et al. 2005). To do so, CASIPEDIA (2017) was developed as a working platform to (1) allow regular interactions with innovators, sponsors, brokers and users of sustainable innovations; (2) understand the roles of key stakeholders (see Table 1.1); and (3) recognise important mutual learning processes.

Observations from 202 selected case studies show that SI *Finance*, *Developing*, *Dissemination and communication*, *Diffusing*, and *Testing and Piloting* are among the top key roles of innovators, sponsors, brokers and users. Concerning common mutual learning strategies, the following emerged as moderately to highly used with

70% of the case studies engaged in *learning-by-doing and interaction*, 54% *promoting capacity building, training and tutorials*, 49% *organising regular networking events*, 48% *using prototyping and piloting activities*, 45% *supporting seminars, conferences and Web 2.0 interactions*, 42% *utilising stakeholder workshops*, 37% *conducting in collaborative research*, and 23% *conducting stakeholder interviews*. All these mutual learning strategies were to some extent used in the development and piloting of CASI-F.

1.3 CASI-F Principles: Code of Practice

1.3.1 Responsible Governance

CASI-F was developed taking into account basic principles of good governance (EC 2001) where: (1) *openness* emphasises the need for efficient and transparent communication of activities to the public; (2) *participation* reinforces the confidence of the institutions by promoting a wide participation in policymaking; (3) *accountability* requires more clarity and responsibility from those who formulate and implement policies; (4) *effectiveness* demands more effective, timely, objectives-aligned, proportionate and impact-evaluated policy initiatives; and (5) *coherence* involves reliability and consistency in public policies and actions. CASI-F meets these principles through: sharing of SI initiatives in CASIPEDIA (*openness*); engaging multiple actors (*participation*); dynamic assessment of SI practices, outcomes and players (*accountability*); generating SI actions from systematic SI initiatives analysis (*effectiveness*); and co-producing advice at strategic, tactical and operational levels (*coherence*).

1.3.2 Practical Advice Orientation

Ensuring that the mapping of '*innovations'*, '*policies'* and '*aspirations'* (i.e. citizens' visions of sustainable futures) serves multiple purposes, CASI-F approaches, protocols and tools have been designed to carefully reflect the five RACER criteria of the EC's Impact Assessment Guidelines (EC 2009). It does so by being: (1) *Relevant*—closely linked to sustainability objectives by focusing on the assessment of knowledge concerning Societal Challenges in the EU; (2) *Accepted*—by key stakeholders through participatory and mutual learning activities; (3) *Credible*—by using transparent and trustable sources for the mapping of innovations, policies and shared visions of citizens; (4) *Easy*—by designing well-thought yet resource efficient procedures for data collection and the analysis (e.g. online mapping platform); and (5) *Robust*—by providing tools and approaches consisting of systematic and replicable processes (CASIPEDIA for mapping SI initiatives; Ideas Bank for assessing critical issues, etc.).

1.3.3 Multiple Sources of Knowledge

Supporting multi-actor SI assessment and management calls for an inclusive and versatile framework combining evidence, expertise, creativity and interaction-based approaches to gather and generate knowledge (see Popper 2008). The development and implementations of CASI-F required: (1) *evidence* coming from 548 SI cases; (2) *expertise* of innovators and CASI team members, capable of analysing the socio-technical system in which SI cases operated; (3) *creativity* of innovators when brainstorming about possible actions that could potentially increase the sustainability of their innovations; and (4) *interaction* with innovators through numerous interviews and capacity building processes (Popper et al. 2017b).

1.3.4 Multilevel Perspectives and Transitions

A multilevel perspective (MLP) approach was taken to develop and apply CASI-F for the assessment and management of SI 'cases' (niche), SI 'policies' (regime) and SI 'visions' (landscape). The broad range of innovations considered, made several approaches to sectoral systems of innovation (e.g. Malerba 2002), technological systems (e.g. Carlsson 1997) and large technical systems (e.g. Coutard 1999; Geels 2004b) compatible with CASI-F. The MLP approach helps to comprehend changes in socio-technical systems, by analysing multi-systemic transformations that require stakeholders' actions at the strategic, tactical or operational levels (Popper et al. 2017b). Existing mainstream frameworks (see Pope et al. 2004; Singh et al. 2011; Ness et al. 2006; Gasparatos et al. 2007; Hacking and Guthrie 2008; Hansen et al. 2009) had been explored, and include, for example, the life cycle assessment, eco-efficiency, eco-design and footprint analyses. While these frameworks were recognised for their importance in assessing mainly quantitative indicators of sustainability, CASI-F was designed to deal with the more indefinable aspects of SI, and thus it complements but does not replace existing frameworks.

1.3.5 Multi-systemic Assessment and Management

Some 44 indicators were used by CASI-F to evaluate 'positive' impacts in economic, societal, environmental, infrastructural and governmental systems. The results of this assessment helped to identify some 18 criteria where SI made significant multi-systemic transformations (see Table 1.2).

Table 1.2 CASI-F assessment of multi-systemic sustainability

System	Indicator	Positive impact
Economic	Consumption	• • • •
Societal	Social behaviour	• • • •
Societal	Individual behaviour	• • • •
Infrastructural	Energy, water and food supply system	• • • •
Economic	Production	• • • •
Infrastructural	Waste management	• • •
Societal	Social interaction and communication	• • •
Environmental	Rights of future generations	• • •
Infrastructural	Settlements and cities	• • •
Environmental	Protection of renewable resources	• • •
Economic	Local trade	• • •
Environmental	Environmental protection laws and policies	• • •
Economic	Labour and employment	• • •
Infrastructural	Transportation and distribution	• • •
Societal	Education and qualification	• • •
Infrastructure	Knowledge transfer channels	• • •
Environmental	Protection of species and ecological heritage	• • •
Governmental	Political participation and democracy	• • •
Infrastructural	Services supply system	• •
Societal	Individual autonomy and self-determination	• •
Governmental	Government administration	• •
Environmental	Resource extraction policy and practice	• •
Governmental	Industry and Technology policy	• •
Societal	Human health	• •
Infrastructural	Communication and media	• •
Governmental	Public finances and taxes	• •
Societal	Gender and social class/groups equity	• •
Economic	Financial system	• •
Infrastructural	RTDI wiring up and collaborative connections	• •
Economic	International trade	• •
Infrastructural	Other goods supply system	•
Societal	Population development and composition	•
Governmental	New Governance institutions	•
Environmental	Protection of cultural heritage	•
Governmental	Government intelligence	•
Societal	Civil liberties and human rights	•
Infrastructural	RTDI institutions/organisations transformation	•
Infrastructural	Health services	•
Societal	Income distribution and class structure	•
Societal	Social security and ageing provisions	•
Government	Conflict control and resolution	•
Economic	Other macroeconomics transformations	•

(continued)

Table 1.2 (continued)

System	Indicator	Positive impact
Government	Population and immigration policy	•
Government	International assistance and aid policy	•

Note: Negligible to Low [•], Medium [••], High [•••], Very high [••••]
Source: authors' elaboration

Key economic systems criteria: *Consumption* (e.g. re-orienting consumption towards resource efficient solutions); *Production* (e.g. implementing effective circular economy practices); *Labour and employment* (e.g. improving occupational health and safety); *Local trade* (e.g. supporting economically disadvantaged producers).

Key societal systems criteria: *Social behaviour* (e.g. car sharing); *Individual behaviour* (e.g. repairing); *Social interaction and communication* (e.g. crowd-driven clean-up); *Education and qualification* (e.g. carbon conscious lifestyles).

Key environmental systems criteria: *Waste management* (e.g. high-tech reduction of waste); *Protection of renewable resources* (e.g. conscious use of hydro and biomass energy plants); *Rights of future generations* (e.g. using sustainable energy sources); *Protection of species and ecological heritage* (e.g. preserving biodiversity).

Key infrastructural systems criteria: *Energy, water and food supply system* (e.g. vertical agriculture); *Settlements and cities* (e.g. greening the city); *Transportation and distribution* (e.g. cycle to work); *Knowledge transfer channels* (e.g. online SI tutorials).

Key governmental systems criteria: *Environmental protection laws and policies* (e.g. car free city centres); *Political participation and democracy* (e.g. crowdfunded cases).

1.4 CASI-F Methodology: Protocols and Tools for SI Assessment and Management

CASI-F entails a set of interconnected *protocols* (methods) and *tools* (web-based applications), aiming at more effective and efficient assessment and management of SI, as well as related multilevel and multi-stakeholder decision-making.

Figure 1.2 below shows the 42-months development journey of the CASI-F. Overall, the first three steps of the journey were concerned with SI assessment, including the nomination of SI cases; the mapping SI practices, outcomes and players; and the analysis of critical issues, which were then used to draw some 60 managerial lessons, as well as 50 critical factors clustered around ten key aspects

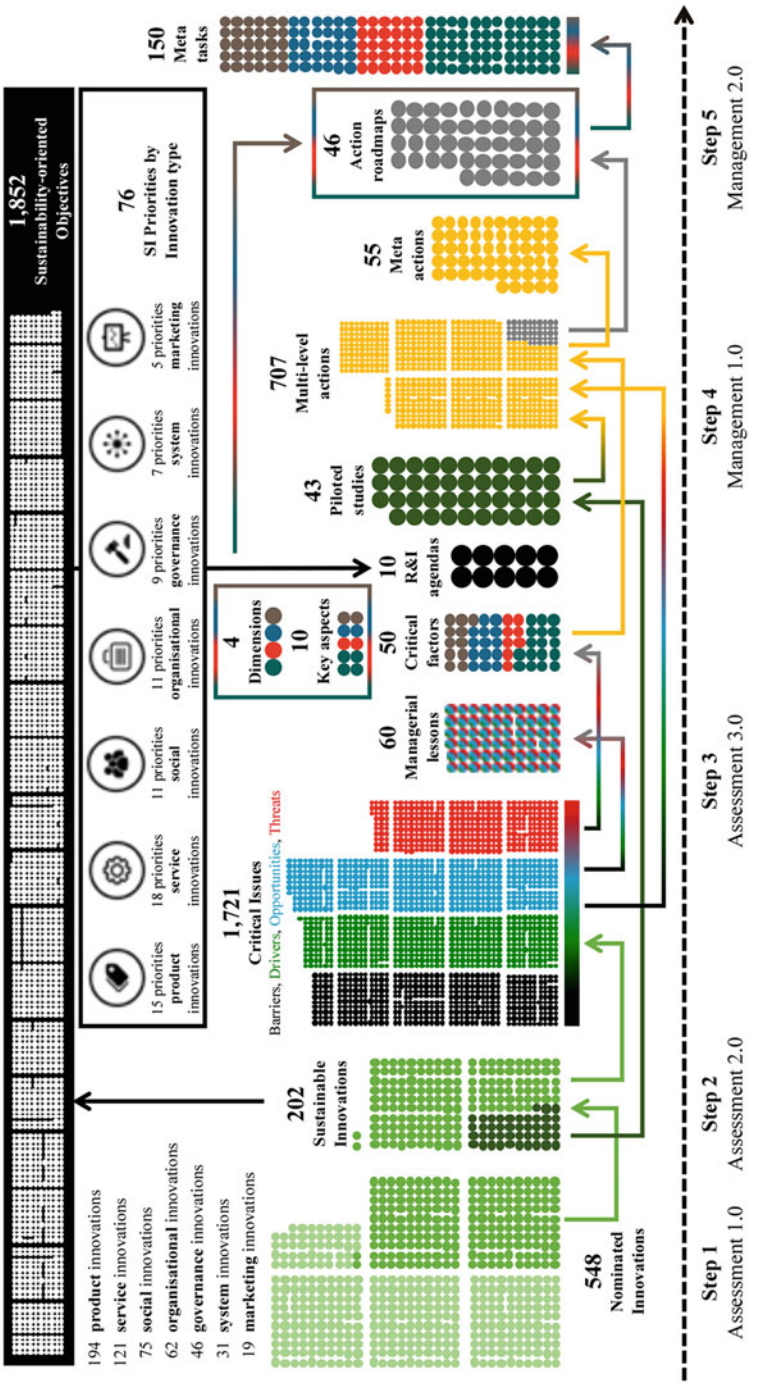

Fig. 1.2 The evolution of the CASI framework. Source: authors' elaboration

and four dimensions of SI (fully documented in Popper et al. 2016a and summarised in Chap. 9). The insights that emerged from the application of Steps 1 to 3 of CASI-F were utilised to fine-tune Steps 4 and 5, concerned with the management of SI. All in all, the systematic piloting of CASI-F resulted in 707 multilevel and multi-actor actions linked to multiple critical issues, 46 action roadmaps and 150 meta-tasks (see sect. 1.5). The entire process promoted the interaction between SI actors and explored potential relationships.

The five-step approach of CASI-F consists of:

- *Environmental and horizon scanning* protocols and tools to identify national and international 'innovations', 'policies' and 'visions' relevant to the grand societal challenge of 'climate action, environment, resource efficiency and raw materials'.
- *Multi-criteria analysis and assessment* protocols and tools to assess practices, outcomes and players related to prioritised innovations, policies and visions based on criteria relevant to sustainability-oriented innovation processes.
- *Critical issue analysis and assessment* protocols and tools to analyse selected innovations, policies and aspirations with the purpose of identifying and prioritising critical issues, i.e. barriers, drivers, opportunities and threats that can affect the sustainability of innovations.
- *Multilevel advice management* t protocols and tools to generate and prioritise actions for multiple stakeholders at the strategic, tactical and operational levels in order to better manage critical issues.
- *Action roadmaps management* protocols and tools to develop roadmaps with short-medium-to-long-term tasks for the implementation of multilevel actions.

Source: Popper et al. (2017b)

The CASI-F journey is far from over. A growing number of post-CASI follow-up projects and initiatives have fully or partially adopted CASI-F (sometimes with minor sector-specific adaptations) as the methodological backbone of their foresight research and sustainable innovation processes. Therefore, the evolution of CASI-F would inevitably require Fig. 1.3 to be updated in years to come (see Sect. 1.6).

1.4.1 Step 1: Environmental and Horizon Scanning

Step 1 focuses on the scanning and nomination of SI cases relevant to priority areas related to Climate Action, Environment, Raw Materials and Resource Efficiency (see Table 1.3).

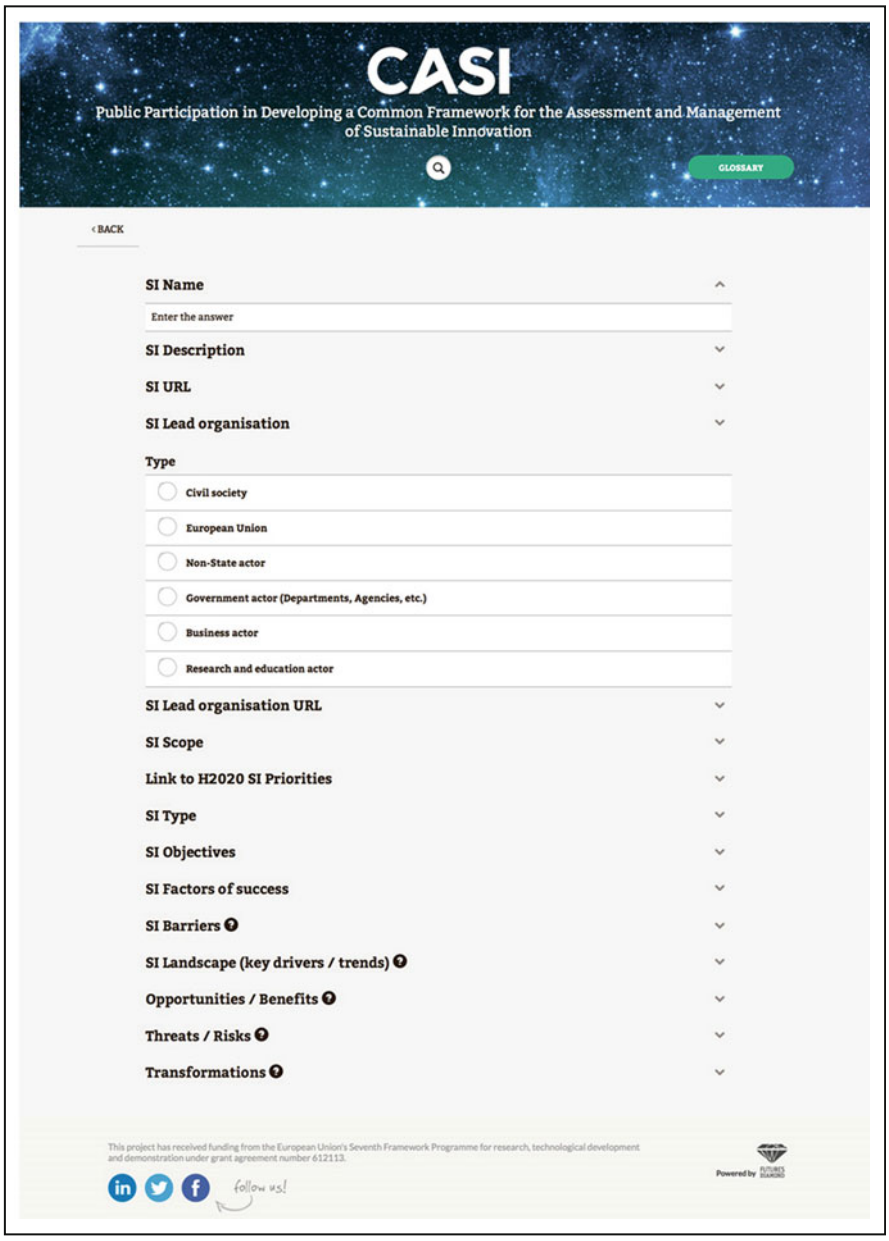

Fig. 1.3 CASI-F tool for sustainability relevance and scanning. Note: SI nomination tool http://www.futuresdiamond.com/casi2020/casipedia/map-a-case/ Source: Futures Diamond Ltd

Table 1.3 Priorities in climate action, environment, resource efficiency and raw materials

Climate action	1. Climate change projections and scenarios. 2. Climate change adaptation solutions. 3. Climate change mitigation solutions. 4. ICT to assess and predict climate actions. 5. Climate action by sustainable lifestyle. 6. Climate action eco-innovation policies.
Environment	7. Biodiversity examination and understanding. 8. ICT mapping natural resources and trends. 9. Solutions for cultural heritage assets. 10. Strategic intelligence and citizens' participation.
Resource efficiency	11. Solutions for water imbalances. 12. ICT systems improving resource efficiency. 13. Resource efficient sustainable lifestyles. 14. Eco-innovation and green economy transition.
Raw materials	15. Long-term raw materials availability. 16. Solutions to explore, extract, process and recycle. 17. Alternative raw materials. 18. Awareness on raw materials shortage. 19. ICT systems to map raw materials trends. 20. Eco-solutions to reduce raw materials use. 21. Raw materials conscious sustainable lifestyle. 22. Effective raw materials policies.

Note: See Council of the European Union (2013) and Popper et al. (2016b)

Nominated cases, which covered all 21 International Standard Industrial Classification (ISIC) economic activities, were first reviewed by a panel of sustainability experts in terms of their relevance to the above-mentioned 22 priorities. A second independent assessment was conducted by three CASI partners. The latter involved five criteria: *(1) Degree of public participation and mobilisation*; (2) *Degree of sustainability and cross-sectoral linkages*; (3) *Degree of multi-dimensional transformations*; (4) *Degree of deployment and diffusion*; (5) *Degree of novelty and originality*; and rated on a 1 to 5 scale. A scoring system was then created and the six highest scoring cases from 28 European countries were chosen. In total, 202 innovations were selected for a 'deep dive' assessment (see Sect. 1.4.2). Overall, CASI-F protocols for Step 1 consist of 15 criteria: *Name*, *Description*, *URL*, *Lead organisation*, *Lead organisation URL*, *Scope*, *Link to H2020 priorities*, *Type*, *Objectives*, *Factors of success*, *Barriers*, *Drivers*, *Opportunities*, *Threats* and *Multi-systemic transformations*.

The assessment of initiatives against these criteria can be conducted by the innovator, a trained mapper or collectively by a group of experts or CASIPEDIA users invited to assess a given SI initiative using an online tool (Fig. 1.3).

Table 1.4 CASI-F criteria for the fully fledged assessment of SI

SI practices assessment criteria	SI outcomes assessment criteria	SI players assessment criteria
1. Name	22. Degree of outcomes	31. Innovators
2. Description	23. Status of outcomes	• Role
3. URL	24. Strengths and weaknesses	• Type
4. Lead organisation	25. Opportunities/threats	• Contact details
5. Lead organisation URL	26. Policies	32. Sponsors
6. Scope	27. Spin-offs	• Role
7. Date range	28. Publications	• Type
8. Link to H2020 priorities	29. Skills and competences	• Contact details
9. Type	30. Systemic sustainability	33. Brokers
10. Objectives	• Economic systems (7 indicators)	• Role
11. Origins	• Infrastructural systems (11 indicators)	• Type
12. Factors of success	• Governmental systems (9 indicators)	• Contact details
13. Barriers	• Societal systems (11 indicators)	34. Users
14. Drivers	• Environ. systems (6 indicators)	• Role
15. Tensions		• Type
16. Funding/market potential		• Contact details
17. Mobilisation degree		
18. Mutual learning processes		
19. SI transferability		
20. Similar SI elsewhere		
21. SI assessment methods		

Source: Popper et al. (2017d)

1.4.2 Step 2: Multi-criteria Analysis and Assessment

Step 2 of CASI-F encompassed a multi-criteria analysis and assessment of SI cases in terms of their practices, outcomes and players. The information was collected through desk research and interviews facilitated by CASIPEDIA knowledge co-creation tool. Thirty-four criteria were included in the 'deep dive' assessment (Table 1.4):

- The assessment of SI *practices* provided an overview of the innovation, including an assessment of objectives, origins, factors of success, barriers, drivers, mobilisation degree, mutual learning processes, transferability and similar initiatives elsewhere.
- The assessment of SI *outcomes* included nine criteria. The first two focused on the degree (incremental to radical) and status of the SI outcomes, followed by an assessment of strengths and weaknesses, opportunities and threats, policies, spin-offs, publications, skills and competences. Multi-systemic sustainability was also assessed with 44 indicators exploring the positive contributions to five subsystems of a socio-technical system.
- The assessment of SI *players* considered four types of stakeholders, including innovators, sponsors, brokers and users.

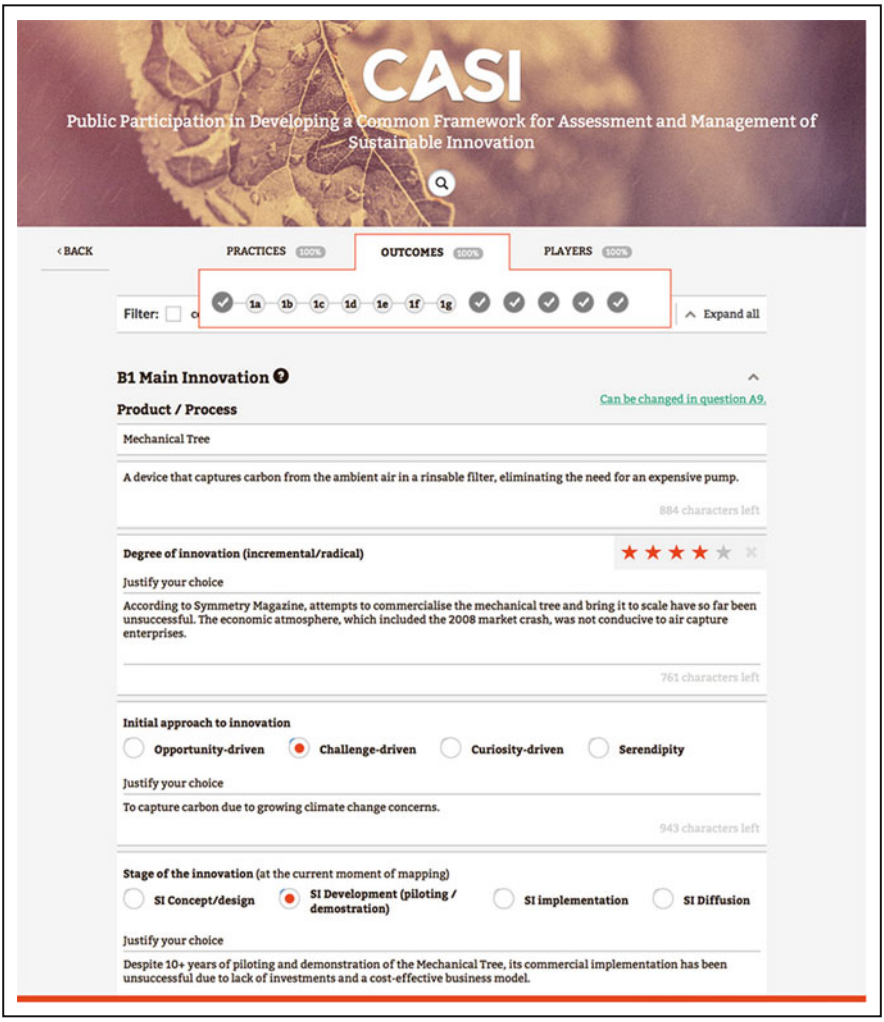

Fig. 1.4 CASI-F tool for multi-criteria analysis and assessment. Source: Futures Diamond Ltd

The multi-criteria analysis required the implementation of a knowledge co-creation tool enabling collaborative assessment directly by the innovators or through invitations sent to the sponsors, brokers and users of an innovation (see Fig. 1.4). From the 202 case studies, most of them (65%) were challenge-driven innovations, followed by opportunity-driven cases (29%), and only a few curiosity-driven (4%) or the result of serendipity (2%). Concerning the degree of innovation, 47% were incremental while the remaining 53% were radical. With regards to the innovation process stage, CASI-F mainly targeted cases at their *implementation* (33%) and *diffusion* stages (52%), but later we allowed its application to a few cases in *concept design* (2%) and *development/demonstration* (13%) stages.

1.4.3 Step 3: Critical Issue Analysis and Assessment

Step 3 of CASI-F involves the analysis and assessment of critical issues, including barriers, drivers, opportunities and threats of seven types (i.e. technological, environmental, economic, political, social, ethical and spatial) that could potentially affect the development and success of SI. During the CASI-F pilot over 1500 critical issues were identified and prioritised in collaboration with 43 innovators (the analysis of these revealed 60 managerial lessons discussed in Chap. 9). The suggested procedure to prioritise critical issues involves their rating in terms of *importance* for broader sustainability goals and *urgency* for the successful implementation or diffusion of the SI (see Fig. 1.5). However, the prioritisation criteria should be flexible enough to accommodate the immediate needs of the innovators, e.g. market penetration, job creation or economic/technological feasibility can be equally valid alternative criteria. 'Critical issues' that required further consideration for management decisions were mapped against selected cases with the active involvement of SI actors. The 'critical issues', unless restricted due to confidentiality, are available online in the CASI Ideas Bank (see Fig. 1.6).

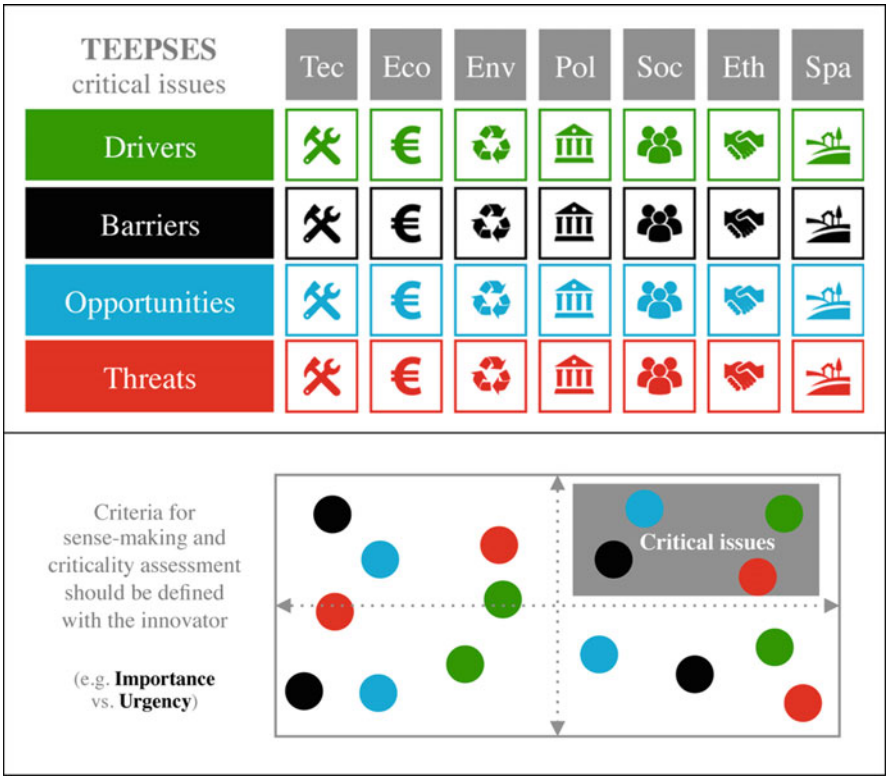

Fig. 1.5 CASI-F tool for critical issue analysis and assessment. Source: Authors elaboration

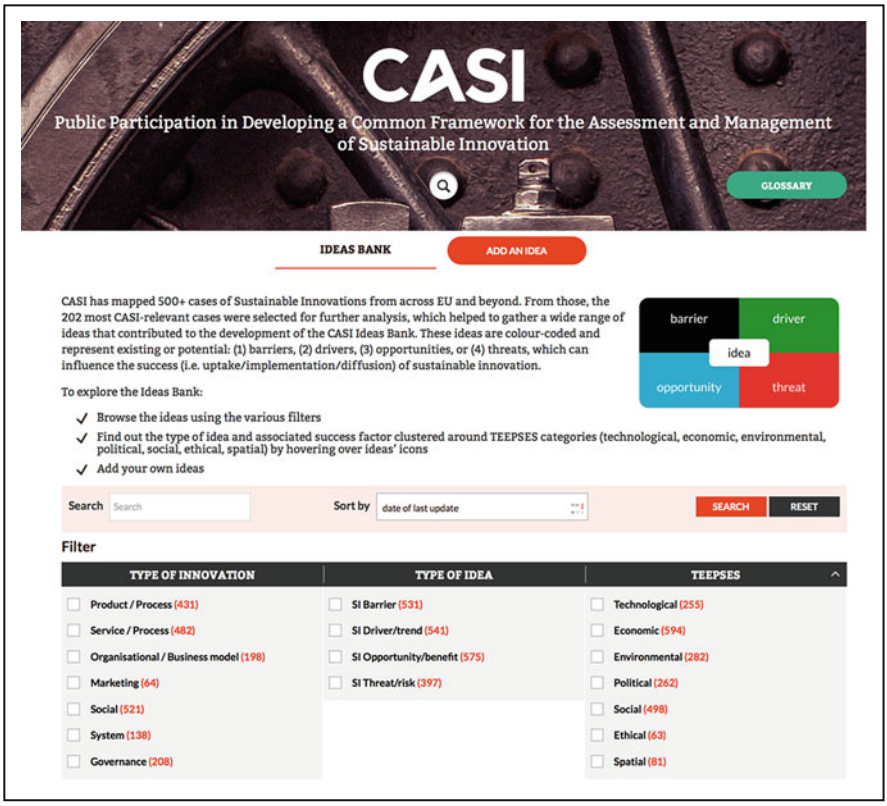

Fig. 1.6 CASI-F tool for multi-criteria analysis and assessment. Note: Ideas Bank tool URL http://www.futuresdiamond.com/casi2020/ideas-bank/ Source: Futures Diamond Ltd

Despite the CASI 'project' and awarded EU funding having finished in 2017, both CASI-F and related tools remain alive thanks to the active role of 3 of the 19 CASI founding partners (Manchester Institute of Innovation Research of The University of Manchester, The Interuniversity Research Centre on Public Services of the University of Milano-Bicocca and Futures Diamond Ltd) and an early adopter (VTT Technical Research Centre of Finland Ltd). Between 2018 and 2019 CASIPEDIA gained over 100 new cases through a win-win collaboration with a module on 'Management for Sustainable Innovation' within a Master Programme on 'Management and Design of Services' from the University of Milano-Bicocca and over 500 new critical issues have been entered into the Ideas Bank to date. Given that CASIPEDIA users can restrict the visibility of the data, not all cases and ideas are available for the general public; however, figures available to the system administrators show some 600 cases with over 2000 critical issues, more or less evenly distributed between barriers (26%), drivers (26%), opportunities (28%) and threats (19%). These figures show the versatility and effectiveness of CASI-F.

1.4.4 Step 4: Multilevel Advice Management

A multilevel actions approach was used in Step 4 to provide advice to the quadruple helix of SI actors (see Table 1.5). One of the main lessons from the analysis of identified critical issues was that the implementation of relevant actions requires the active involvement of multiple actors with diverse managerial roles and responsibilities. Upon completion of the CASI project some 707 managerial actions were generated: 190 for government, 186 actions for business, 175 actions for civil society and 156 actions for research and education. However, at the time of writing, the Actions Bank tool in CASIPEDIA recorded some 951 actions, representing a 35% increase, which clearly shows that CASI-F continues to support multilevel decisions-making for different SI types, including: 35% Service innovations, 26% Social innovations, 13% Product innovations, 12% Organisational innovations, 6% Governance innovations, 5% System innovations and 3% Marketing innovations. The distribution of actions among actors and the three management levels was relatively even (37% strategic, 32% tactical and 31% operational). The mapping of actions is conducted through an online tool that allows innovators and CASIPEDIA users to suggest actions (see Fig. 1.7) and link them to critical issues. The tool requires mappers to indicate the responsible actor, implementation timeframe, action type (e.g. reinforcing, initiating, maintaining or recovering), and a preliminary assessment of the action's importance, feasibility and expected economic, social and environmental impacts.

We recommend suggested actions are assessed in a face-to-face setting together with the innovator; however, CASIPEDIA also allows their rating (Fig. 1.7).

Table 1.5 CASI-F approach to multilevel and multi-stakeholder advice

Multilevel and multi-stakeholder actions approach	Government actors	Business actors	Civil society actors	Research and education actors
Top-level management: Strategic actions	*Strategic actions* involve the definition of high-level aims, challenges, goals, objectives and priorities that require strategic attention or orientation from top-level decision-makers.			
Mid-level management: Tactical actions	*Tactical actions* require mid-level decision-makers to translate strategic objectives and priorities into tactical interventions, such as investment, research or knowledge transfer programmes and calls, funding schemes, instruments and development mechanisms.			
Front-line management: Operational actions	*Operational actions* require interventions from front-line decision-makers—policymakers, civil servants, entrepreneurs, citizens, researchers and workforce—directly responsible for the day-to-day implementation of activities linked to tactical and strategic actions.			

Source: Popper et al. (2017b)

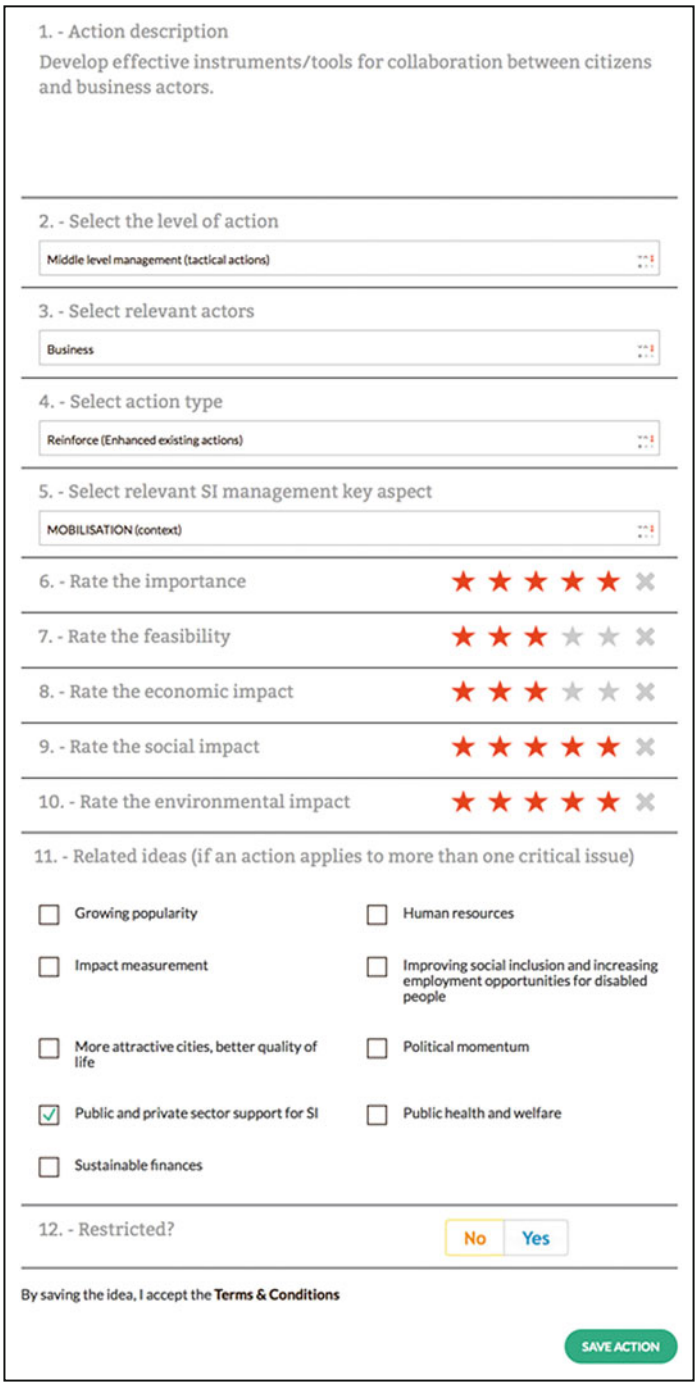

Fig. 1.7 CASI-F tool for multilevel advice management. Note: Action Bank tool URL http://www.futuresdiamond.com/casi2020/suggest-action/ Source: Futures Diamond Ltd

1.4.5 Step 5: Action Roadmapping Management

Step 5 'Action roadmapping management' was designed to develop more detailed sub-actions that will enable the management of prioritised actions in a systematic and effective way. These sub-actions or specific tasks were planned around four dimensions (i.e. context, people, process and impact) and ten key aspects of management (i.e. momentum, foresight, resources, mobilisation, aptitude, attitude, catalysts, fosterers, transformations and sustainability), which emerged from the meta-analysis of over 1500 critical issues using an innovation systems perspective.

The **context dimension** includes four key aspects: '*Momentum'*, reflecting the potential space for innovation, i.e. expectations of entrepreneurs and other actors, political drive from regulators or procurement, exemplars from other technological or social enterprises, and the perception of problems that call for solutions; '*Foresight'*, showing the capacity to anticipate, strategise and get over gaps in the innovation curve; '*Resources'*, stressing the need for healthy combinations of skills, finance, location, markets, etc.; and '*Mobilisation'*, including the capacity for action, as in public participation, community and institutional support, public–private partnerships, research and education engagement.

The **people dimension** involves two key aspects: '*Aptitude'*, referring to the actual skill-set or competences of people involved in the design, development, implementation and diffusion of an innovation; and '*Attitude'*, refers to their behaviour and motivation.

The **process dimension** includes two key aspects: '*Catalysts*', contributing to initiate, develop and implement the innovation; and '*Fosterers*', including factors that further consolidate and diffuse the innovation.

The **impact dimension** consists of two key aspects: (multi-agent) '*Transformation'*, meaning positive changes in the quadruple helix of SI knowledge production (see also Carayannis and Campbell 2009, 2010); and (systemic) '*Sustainability*', referring to changes in the socio-technical system where the SI operates that lead to positive environmental, societal, economic, government and infrastructure transformations.

Source: Popper et al. (2017b)

In total, 46 action roadmaps were created during the piloting phase involving 43 innovators from 12 European countries (45% business actors, 26% civil society actors, 11% research and education actors and 9% government actors). Overall, applying Step 5 of CASI-F (see Figs. 1.8 and 1.9) resulted in over 500 specific tasks of which 38% were short term, 34% medium term and 28% long term. Nearly half of the tasks (47%) aimed at *reinforcing* or improving existing activities, while 36% of suggested actions were *initiating* new sustainability-oriented processes. The remaining actions were related to tasks *maintaining* the 'status quo' (9%) or *recovering* previously

tested initiatives (9%) but applying them in different contexts. Understandably, 96% of the actions were deemed highly important and some 81% were considered highly feasible. Regarding their expected positive impacts, the environmental aspects emerge as the most significant (74%) followed by social impacts (68%) and economic benefits (55%).

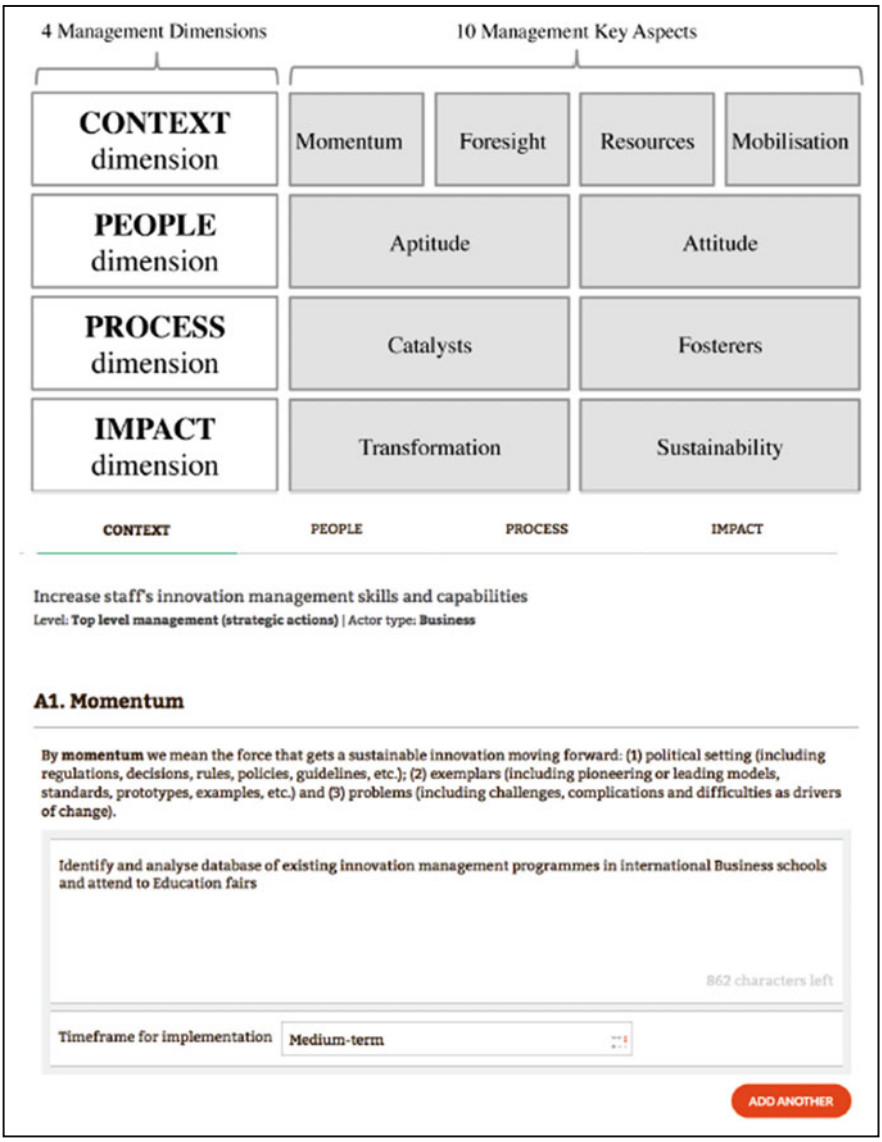

Fig. 1.8 From tasks to meta-tasks. Source: Authors elaboration

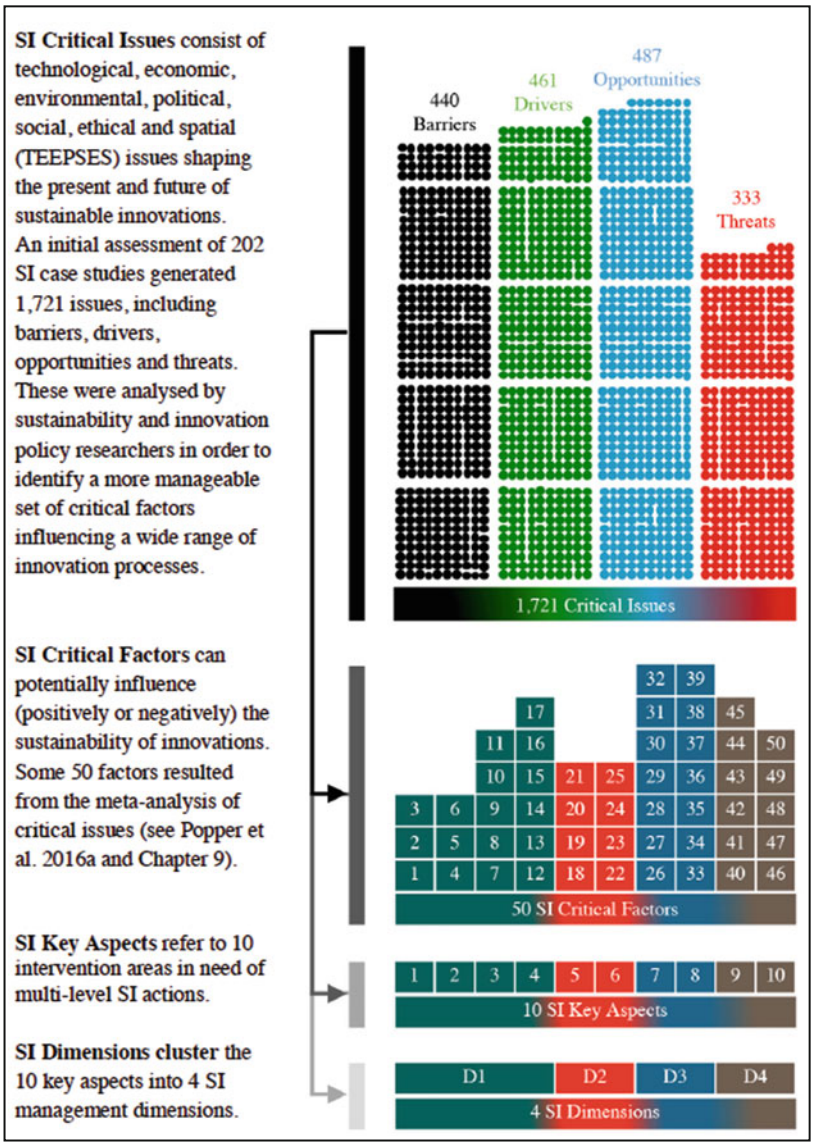

Fig. 1.9 CASI-F tool for multilevel advice management. Source: Authors elaboration

An interview-based evaluation of the piloting of CASI-F conducted by Inova+ (see Anttila 2016) showed that most innovators (86%) considered that the Action Roadmaps were helpful to better manage their sustainable innovation. Certainly, the immediate application of CASI-F is expected to bring innovation-specific benefits; however, its wider use and meta-analysis of action roadmaps can translate into more generic lessons, such as the 150 meta-tasks discussed below (see Sect. 1.5).

1.5 CASI-F Evaluation: Lessons from CASI-F Pilots and Further Applications

Through the pilot exercise (see Martin and Avarello 2016; Schultze et al. 2016) 43 innovators were assisted in developing and implementing an action roadmap, broken down into detailed tasks, in order to better manage the most urgent and important critical issues. Interviews with the innovators revealed high levels of approval, with 80% of the innovators finding the process satisfactory and 77% considered following the recommendations (Anttila 2016). Respondents highlighted the usefulness and efficiency of the methodology, and thought it was 'structured', 'new' and 'interesting'. Over 500 specific tasks, generated during the roadmapping exercise, were subject to a sense-making process led by Inova+ team—one of the CASI project partners who analysed the tasks, identified 353 themes, and clustered them by type of actor (government, business, civil society and research/education) and level of management (strategic, tactical and operational). The second round of analysis was conducted by a group of researchers from the University of Manchester. The team re-clustered the themes and arrived to 15 meta-tasks per each of the 10 key management aspects, thus concluding the pilot with a total of 150 meta-tasks or managerial lessons (see Fig. 1.10 for process outline).

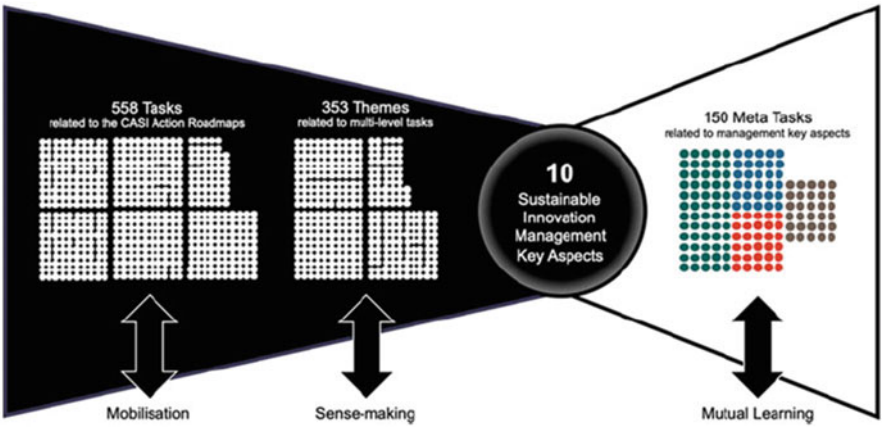

Fig. 1.10 On SI Critical Issues, Critical Factors, Key Aspects and Dimensions. SI Critical Issues consist of technological, economic, environmental, political, social, ethical and spatial (TEEPSES) issues shaping the present and future of sustainable innovations. An initial assessment of 202 SI case studies generated 1721 issues, including barriers, drivers, opportunities and threats. These were analysed by sustainability and innovation policy researchers in order to identify a more manageable set of critical factors influencing a wide range of innovation processes. SI Critical Factors can potentially influence (positively or negatively) the sustainability of innovations. Some 50 factors resulted from the meta-analysis of critical issues (see Popper et al. 2016a and Chap. 9). SI Key Aspects refer to 10 intervention areas in need of multilevel SI actions. SI Dimensions cluster the 10 key aspects into 4 SI management dimensions. Note: SI Key Aspects and Dimensions provided a frame for CASI-F Action Roadmaps. Source: Authors' elaboration

There are many more lessons from the application of CASI-F. For example, a meta-analysis of short-medium-to-long-term objectives and aspirations of innovators helped the authors to identify 76 priority areas of product, service, social, organisational, governance, system and marketing innovations, as well as some top 10 research and innovation policy agendas resulting from them (see Popper et al. 2017a). However, for space limitations and given that our focus is on methodology and managerial issues, sustainability research and policy relevant lessons are not reported in this chapter.

Fifteen lessons for SI managers on key aspect 1: Momentum

1. Analyse the competition.
2. Analyse existing training programmes.
3. Analyse top-level and strategic management structures.
4. Benchmark communication channels by target group.
5. Create guidelines for industries.
6. Gain senior management buy-in.
7. Identify and study best practices and state of art of the field.
8. Identify critical issues and challenges.
9. Identify high-level objectives for project impacts.
10. Identify new/relevant partnerships, networks and investors.
11. Identify relevant people and regulations in politics.
12. Identify relevant structures and frameworks.
13. Improve business practices (e.g. standards, certificates and tools).
14. Organise site visits.
15. Strengthen promotional/marketing channels (brand image).

Fifteen lessons for SI managers on key aspect 2: Foresight

16. Conduct inventory of strategic targets and projects.
17. Create an internal and external communication strategy.
18. Differentiate "buzzes" from trends.
19. Develop staff expertise and knowledge on future trends.
20. Engage into existing dialogue on topic with leading experts.
21. Engage the public in relevant decision-making processes.
22. Explore platforms/tools for communication and collaboration.
23. Identify emerging business models, trends and innovations.
24. Identify mutual objectives with other actors.
25. Identify new target groups, potential investors and alliances.
26. Monitor events, news, articles and conferences.
27. Organise brainstorm sessions to identify new ideas.
28. Scan the horizon for trends, practices and opportunities.
29. Select strategic objectives and set up related activities.
30. Set up umbrella organisations to deal with market changes.

Fifteen lessons for SI managers on key aspect 3: Resources

31. Apply for local/national/international funding with the right partners.
32. Attract business partners, investors and collaborators.
33. Choose a spokesperson and lobby for resources.
34. Conduct an inventory of infrastructure needs.
35. Develop infrastructures for monitoring and marketing.
36. Engage local citizens and local businesses as partners.
37. Evaluate and improve education material.
38. Expand geographical coverage with economics of scale.
39. Explore crowdfunding opportunities and innovation contests.
40. Facilitate internal knowledge-exchange.
41. Gain access to data on best local, national and global practices.
42. Generate information on relevant reference cases.
43. Identify and monitor existing relevant databases.
44. Include funding opportunities into concept development.
45. Map and manage resources (e.g. limiting target groups).

Fifteen lessons for SI managers on key aspect 4: Mobilisation

46. Conduct pilots encouraging sustainable values.
47. Create multimedia content and social media campaigns.
48. Develop real-time communication channels.
49. Engage in knowledge-exchange with similar projects.
50. Engage regional and local stakeholders.
51. Find advocates by launching competitions.
52. Gain internal support from management.
53. Identify existing expansion strategies.
54. Identify new stakeholders and strengthen existing networks.
55. Identify training needs and develop new training methods.
56. Improve the relationship with policymakers and investors.
57. Increase the transparency in the decision-making process.
58. Organise workshops and roadshows to increase awareness.
59. Promote public participation and citizen engagement.
60. Seek endorsements, references and success stories.

Fifteen lessons for SI managers on key aspect 5: Aptitude

61. Accumulate knowledge with stakeholders and partners.
62. Adapt to different contexts, e.g. language, environment.
63. Attract strategic partners and use public participation.
64. Create exciting educational/training material (for trainers).
65. Develop critical skills (foresight, leadership, negotiation).
66. Educate public on the impact of the innovation.
67. Enable internal knowledge sharing (e.g. away days).
68. Enable external knowledge exchange (e.g. study visits).
69. Encourage mutual motivation among team members.

70. Engage administrators/managers in critical issues mapping.
71. Engage stakeholders in innovation and idea generation.
72. Foster creativity, research skills and networking.
73. Identify correct contact points for stakeholders.
74. Implement systematic evaluation system.
75. Matching correct people with correct tasks.

Fifteen lessons for SI managers on key aspect 6: Attitude

76. Create an innovation culture with social responsibility.
77. Disseminate facts on positive impacts of the innovation.
78. Encourage enthusiasm and commitment to learn.
79. Engage high-profile people as ambassadors and mentors.
80. Foster interpersonal and communication skills.
81. Foster optimism, engagement and collaboration.
82. Increase understanding of customer needs and end-users.
83. Involve your staff in public relations (PR) events to gain a shared vision.
84. Involve top managers in attitude-changing campaigns.
85. Implement incentives for personnel engagement.
86. Nurture dialogue between employees and local community.
87. Promote cost-savings and quality-improvement spirit.
88. Recruit people passionate about the cause.
89. Train ambassadors for the cause internally and externally.
90. Use several methods/tools to measure satisfaction.

Fifteen lessons for SI managers on key aspect 7: Catalysts

91. Apply for multiple sources of funding.
92. Collaborate with local and national media.
93. Conduct ex ante evaluation of the innovation process.
94. Conduct pilots and testing with specific target groups.
95. Identify scalability challenges and react accordingly.
96. Initiate cooperation and networks to reach larger audience.
97. Introduce learning-by-doing methods to deepen knowledge.
98. Involve employees and stakeholders in testing.
99. Involve key business partners in research activities.
100. Involve new actors at different stages of the process.
101. Launch educational material on the innovation's impacts.
102. Launch targeted PR and communication campaigns.
103. Organise crowdfunding campaigns.
104. Segment shareholders into groups.
105. Use bottom-up processes in the development phase.

Fifteen lessons for SI managers on key aspect 8: Fosterers

106. Analyse competition.
107. Analyse existing training programmes.
108. Analyse top-level and strategic management structures.

109. Benchmark communication channels by target group.
110. Create guidelines for industries.
111. Gain senior management buy-in.
112. Identify and study best practices and state of art of the field.
113. Identify critical issues and challenges.
114. Identify high objectives for project impact.
115. Identify new/relevant partnerships, networks, and investors.
116. Identify relevant people and regulations in politics.
117. Identify relevant structures and frameworks.
118. Improve business practices (standards, certificates, tools).
119. Organise site visits.
120. Strengthen promotional/marketing channels (brand image).

Fifteen lessons for SI managers on key aspect 9: Transformation

121. Consolidate emerging players and promote spin-offs.
122. Create knowledge-based products and services.
123. Create targeted campaigns on the impact.
124. Engage multi-actors visioning and paradigm shifting.
125. Foster sustainability in targeted geographical areas.
126. Foster transferability between different sectors.
127. Gather positive socio-economic and environmental stories.
128. Increase community sense and young people engagement.
129. Promote entrepreneurship and innovations skills.
130. Promote positive cultural and behavioural change.
131. Provide user-friendly information to stakeholders.
132. Refocus goals and priorities based on impact assessment.
133. Support the development of competences and skills.
134. Use innovative marketing to promote sustainable lifestyles.
135. Use job creation as measurement of impact.

Fifteen lessons for SI managers on key aspect 10: Sustainability

136. Allocate resources to support sustainable innovations.
137. Create self-sustainable sustainability campaigns.
138. Develop green and social solutions in rural and urban areas.
139. Develop transparent public engagement strategies.
140. Emphasise the economic, social and environmental impacts.
141. Expand the network and collaborate with local stakeholders.
142. Identify critical markets in need for sustainable innovations.
143. Identify new ways to encourage cost and energy savings.
144. Implement new regulations and incentives for sustainability.
145. Share knowledge on green firms, products and services.
146. Push for wider use of sustainability indicators and targets.
147. Refocus priorities and goals based on impact assessment.
148. Seek sustainability assessment and management advice.
149. Share sustainability best practices and infrastructures.
150. Support increasing deployment of sustainable services.

1.6 CASI-F Applications: Practical Uses in Multiple Geographical and Sectoral Settings

A pilot study was conducted to test the application of CASI-F on 43 innovations: 12 Social innovations, 10 Service innovations, 7 Organisational innovations, 5 Product innovations, 4 Governance innovations, 2 Marketing innovations and 2 System innovations. The pilot validated the effectiveness of CASI-F in supporting the assessment and management of SI in a variety of settings. In terms of sectoral application, the most common sectors in which the innovations operated were energy, education, water, agriculture, ICT, and health/social services, among others. Regarding the geographical scope, around 50% of the innovations were national, 30% local and 20% international. The final outcome of the CASI-F pilot methodology, i.e. 46 actions roadmaps demonstrated that the Framework can empower a wide range of SI types. Its versatility allows for the adaptation and application of CASI-F to other societal challenges, e.g. Health, Secure Societies, etc. Furthermore, since the completion of the CASI project, CASI-F has been used and applied in several successful projects/proposals, some examples of which include: Furthermore, since the completion of the CASI project, CASI-F has been used and applied in several successful projects/proposals. Some examples of which include: multiple action roadmaps on forest-based bioeconomy areas in Uruguay (Popper et al. 2020a); an action roadmap for a sustainability-oriented 'Innovation Centre' in Australia; several action roadmaps for VTT Lighthouses on 'good life' and 'industrial renewal' (VTT 2018); a proposal on technology and action roadmapping for sustainable innovations for bamboo-based products in China; a study on sustainable work, skills, education and related policies in developing economies (Popper and Loikkanen 2019; Loikkanen and Popper 2020), a set of deep space policy priorities in the UAE (Alhashmi et al. 2020; Alhashmi and Popper 2020; Popper et al. 2020b), and the framing of the Universal Foresight Observatory (UFO). These examples of diverse application of CASI-F clearly demonstrate its multi-faceted nature and rapid uptake across sectors and geographical settings.

1.7 CASI-F Evolution: Towards a More Sustainable Future for SI Assessment and Management

The growing variety and number of CASI-F applications have helped the authors identify some possible trajectories for its future evolution (Popper et al. 2017a):

- *CASI-F for Complex Institutional Landscape Management*: the innovators from firms and institutions that piloted CASI-F have mainly selected critical issues that, using a Multi-Level Perspective (MLP) approach, required the assessment and management of niche- and regime-level actions. Therefore, future applications of CASI-F could explore the role of private sector strategies in relation to the

political dimension of SI (i.e. applying CASI-F to companies and organisations interested in sustainable innovation landscape management, see also Pinkse 2019).

- *CASI-F for Unsustainable Innovations*: while CASI-F has been applied to successful/sustainable innovations it could also be used to assess and manage failures by drawing lessons from critical issues and actions.
- *CASI-F for Early Stage Innovations*: another potential application of CASI-F could be to support innovations at their conceptual and prototyping stages. To do so, the Framework would need to be revised to include some *ex ante* impact assessment criteria.
- *CASI-F for Global Value Networks*: in order to offer a real 'sustainable value' the CASI Framework ought to incorporate the systemic assessment and management of interconnected innovations.
- *CASI-F in new contexts*: submitting project proposals and papers exploring the use of CASI-F as a methodological framework in new contexts, e.g. Horizon Europe's Missions, and at the same time improving its outreach and impact.
- *Successful application of CASI-F outside of the CASI consortium*: the CASI-F bank of SI initiatives—CASIPEDIA—continues to be a source of information to the academic community, as well as a public engagement tool for students and researchers. Dozens of new case studies were mapped in the system following the completion of the CASI project.
- *The future of CASI-F protocols and tools*: the Framework could be further elaborated by applying hybrid approaches to foresight-driven technology assessment (see Chodakowska 2020) or incorporating into existing or new steps, some ISO sustainability standards and more quantitative assessment methods and tools (e.g. LCA, see also Chap. 10). Such could be added as a cross-cutting activity across all steps of the CASI-F approach, or as a preliminary task.
- *CASI-F for capacity building*: a free online tutorial, with 12 units structured around 6 modules, has been offering a comprehensive review of sustainable innovation related topics and introducing CASI-F to over 400 participants from more than 60 countries. The CASI Tutorial could be expanded or adapted to support undergraduate, postgraduate and executive education programmes on sustainable innovation (http://www.futuresdiamond.com/casi2020/tutorial).

1.8 Conclusions and Reflections on Learning from Experience to Shape the Future

The chapter presented a five-step methodology supporting the (co-)assessment and (co-)management of SI. CASI-F is the result of a highly intensive and inductive effort of learning from evidence to shape the future, including its own:

- *The environmental and horizon scanning* activities (Step one of CASI-F) to assess *innovations*, *policies* and *visions*—relevant to the grand societal challenge

of 'climate action, environment, resource efficiency and raw materials'—helped us recognise that all innovation categories are favourable to SI. In terms of their positive transformational potential, *product* and *system* innovations are the most valued by experts, followed closely by *social* and *service* innovations. However, evidence from SI cases show that *organisational*, *governance* and *marketing* innovations can lead to significant positive transformations in economic systems, through sustainable consumption and production practices; societal systems, with eco-friendly social and individual behaviours; infrastructural systems, such as energy, water, food supply or waste management networks, etc. (see Table 1.2). Once CASI partners agreed that CASI-F should be relevant to all SI types, a systematic process to nominate SI cases from Europe and the world began. This process, so far, led to over 600 SI cases being entered into a web-based platform called CASIPEDIA, with around half of the cases available for the public, even for unregistered users of the CASIPEDIA platform.

- *The multi-criteria analysis and assessment* activities (Step two of CASI-F)—to assess practices, outcomes and players related to 202 SI cases—allowed us to develop some ten SI policy agendas resulting from the analysis of 1852 short-medium-to-long-term objectives related to these innovation processes (see Popper et al. 2017a and Appendix 1). This step also generated a significant number of critical issues, which also shaped the nature and ultimate purpose of CASI-F as it became imperative for the Framework to focus on the management of those critical issues that were assessed by the innovators as most urgent and important for their own sustainability in the future by achieving strategic agendas and growth targets; improving efficiency in the use of resources such raw materials, knowledge and skills, finance, time, etc.; or by promoting mobilisation and mutual learning through multi-stakeholder engagement at difference stages 'open innovation' processes, for example. Ultimately, the multi-criteria analysis applied to the nominated SI cases led to the SI case studies for the fully fledged application of CASI-F and the selection of 43 pilot cases. A by-product of protocols and tools for the mapping of SI cases is the use of CASIPEDIA by that research and education actors. While we expected researchers (e.g. authors of other chapters in this book) to benefit from the generated repository of knowledge and insights on SI cases, the unplanned yet growing use for CASIPEDIA by lecturers and students in not only encouraging but also increasing the sustainability of CASI-F and related IS knowledge generation process.
- *The critical issues analysis and assessment* activities (Step three of CASI-F) helped to generate some 60 managerial lessons from technological, economic, environmental, political, ethical and spatial perspectives. These were introduced in a report to the European Commission titled 'State-of-the-art of Sustainable Innovation: Climate action, environment, resource efficiency and raw materials' and briefly discussed in Chap. 9. The meta-analysis of critical issues also led to identification of some 50 critical factors, which shaped the future of CASI-F itself and 43 SI pilot cases applying the Framework, as the factors were clustered into ten SI key aspects and four SI management dimensions framing the strategic,

tactical and operational actions to better manage he barriers, drivers, opportunities and threats of SI cases (see Figs. 1.9 and 1.10).

- *The multilevel advice management activities* (Step four of CASI-F) helped to generate over 700 multilevel SI actions for government, business, civil society and research and education actors. Lessons from such a multilevel/stakeholder approach to sustainable innovation actions are discussed in Hölsgens et al. (2017). The volume and variety of generated SI actions for the management of critical issues helped innovators from the selected SI pilots to recognise the need to prioritise them and select the most important yet feasible action(s) to be further elaborated as part of the fifth and final step of the methodology.
- *The action roadmaps management activities* (Step five of CASI-F) helped to fully fledge 46 prioritised actions in the form of well-structured action roadmaps providing 'sound advice' to the innovators in the form of interconnected multitasks. Overall, the 46 roadmaps resulted into 558 interconnected tasks that went through a double-funnel analysis (see Fig. 1.10) where some 353 themes were initially identified and grouped around the 10 SI management key aspects. Finally, a meta-analysis of these tasks helped the authors arrive to meta-tasks providing further SI management lessons and recommendations in a concise and practical baby-tweet-like fashion, which are presented in the form of a series of 15 short and sharp one-liner-advice (see Sect. 1.5) related each of the 10 SI management key aspects.

All in all, the development, piloting and further implementation of CASI-F helped a wide range of stakeholders from multiple sustainable innovation ecosystems to recognise the need to identify, be aware, and act upon the critical issues that can influence different types of SI processes. This, in turn, determines the importance of the CASI-F methodology as a multiplier of SI management processes, and not only 'final' outputs (i.e. the action roadmap), as its main added value is that it proves to be beneficial in changing the management culture of sustainability-oriented innovators, experts, policymakers and civil society actors.

Given that CASI-F uses broadly accepted principles of good governance, multi-systemic impact-oriented criteria and multiple sources of knowledge, the following general conclusions and reflections can be drawn from its current and future applications:

- The systematic and continuous use of CASI-F can improve the governance and management of sustainable innovations through learning from evidence to shape the future. The use of anticipatory intelligence and participatory approaches, especially when addressing critical issues such as barriers, drivers, opportunities and threats, can increase our understanding of multiple stakeholders' roles in decision-making processes shaping the future of sustainable innovations.
- Testing policy intelligence tools with multi-systemic *impact*-oriented criteria. Complex societal issues, such as those that SI actors must deal with, call for the development of instruments capable of supporting SI policy actors in conceiving strategies that are *sound* and *resilient*.

- Combining different *sources of knowledge*. Policymaking shall rely on multi-perspective insights, contributing to more *comprehensive* and *inclusive* SI policy formulations using a multi-stakeholder and multilevel approach to innovation 'policy mixes'. In other words, the systematic assessment and management of critical issues related to societal challenges could help policymakers to better conceptualise and implement sustainable innovation policy agendas that go beyond the obvious combinations of policy instruments (see Flanagan et al. 2011; Cunningham et al. 2016).

The chapter shall be of interest to four types of audiences: *Government actors*—including international organisations and other actors with influence in agenda settings and interest in sustainable innovation trends—can use the information from the mapping to explore practices in areas of policy influence (see also Popper and Velasco 2017); *Business actors* can use the information to identify opportunities and learn how their ideas may contribute to the achievement of global goals and ambitions; *Research and Education* actors can use it to inform the development of new databases and statistics, as well as drive their research careers through relevant research priorities; and last but not least, *Civil society actors*—including non-for-profit organisations, associations, unions and citizens—can learn about SI and management by visiting CASIPEDIA and the CASI-F tutorial, as well as by becoming engaged in the mapping of SI cases relevant to the societal challenge on 'Climate action, environment, resource efficiency and raw materials'. Proactive citizens can learn from this experience and become the engine of change, shaping the future through more sustainable social innovations.

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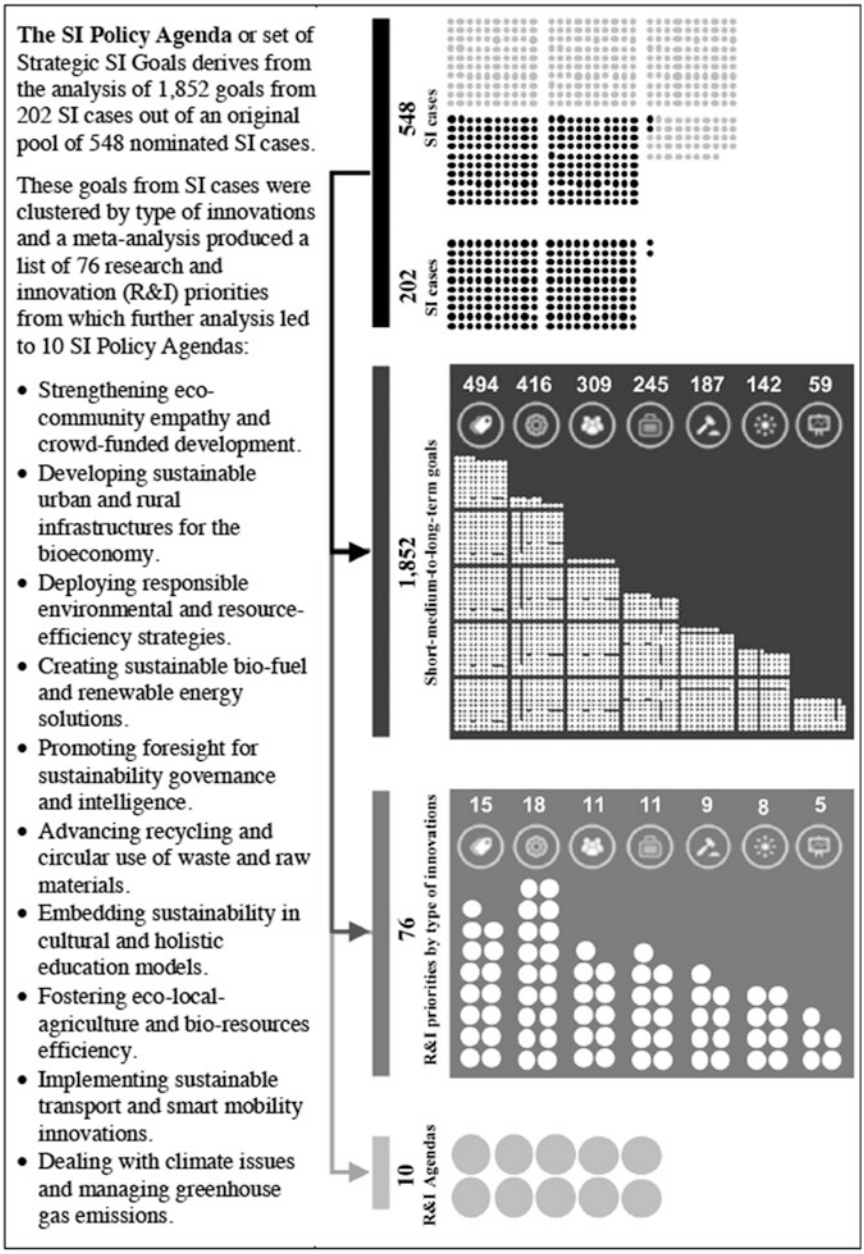
Appendix 1: SI Policy Agendas



Source: Authors elaboration from Popper et al. (2016a, b, 2017a, 2017b, c, d)

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Chapter 2
Sustainable Innovation: Definitions, Priorities and Emerging Issues

Aleš Lipnik and Maja Cergol Lipnik

Abstract The challenges of global societies exert huge pressure on the science community and policymakers to provide solutions that will assure sustainable development. This pressure is evident and results in rapid changes in the concept of innovation systems. These challenges extend beyond national state borders and call for, not only international, but also global action. In addition, it requires a wide range of different stakeholders looking for a multi-policy approach. This chapter presents changes and trends in our understanding of the innovation process and the increasingly important role of different stakeholders involved in the process. Furthermore, it draws on the approach of the EU funded CASI project on 'Public Participation in Developing a Common Framework for the Assessment and Management of Sustainable Innovation' in order to address these questions.

2.1 Introduction

Today we are faced with rapid changes in the development of innovation system concepts. Three major shifts influencing these developments can be observed. The first is a shift towards closer cooperation and networking between the main actors of the innovation system, and their interactions in general. The second shift relates to the increasingly multidisciplinary nature of sustainable innovation, while the third major shift in the perception of the innovation system is manifests through wider societal participation.

Without a doubt, the innovation process involves a growing number of stakeholders. Beyond academia, industry and the government actively contributing to the creation of a general framework for innovation, the role of end-user's knowledge and insights is becoming increasingly important. The knowledge society, which encourages and

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accelerates the production of knowledge, is especially pronounced in the concept of the quadruple and pentacle helix. Overall, interest in innovation and sustainability has increased substantially in recent years. As both, companies and entire nations, receive increasing pressure to consider sustainable development as a way to address social and environmental changes, many have ratcheted up their innovation efforts in order to remain competitive and drive profitable growth (Waite 2014).

This emerging interest in sustainable innovation (SI) also points to a shift from narrow eco-innovation concepts towards broader concepts embracing multiple socio-economic dimensions. In this chapter, this shift will be presented with a review of the existing definitions of SI and the development of such. According to Nidumolu et al. (2013), sustainability is the mother lode of organizational and technological innovation that yields both bottom-line and top-line returns. There are several ways in which companies can benefit from acting in socially responsible and environmentally aware ways. Achieving competitive advantage, building strong corporate brand, and winning the war for talent, are amongst the many examples (Porter and Kramer 2006; Bhattacharya et al. 2008; Hillestad et al. 2010).

The purpose of this chapter is to explore the topic and concepts related to sustainable innovation and to present the readers with relevant SI priorities at both, European and global levels.

This will be presented through a review of contemporary literature on the definitions of innovation with a specific focus on SI, alongside other supporting and complementary concepts. The main goal is to present clear evidence of the growing importance of sustainable innovation in the innovation process, and to demonstrate the ways in which sustainability is a key driver of innovation and its particular relevance in addressing the Grand Societal Challenges, focusing primarily on the fifth Grand Challenge that of "Climate action, environment, resource efficiency and raw materials".

2.2 Development of Innovation Concepts: From Traditional Actors Towards Public Participation

In order to better understand the evolution of innovation concepts, we present a short overview of the development of the main theoretical concepts of the relationship between science and society. According to the traditional view of these relations, three key actors play the main roles in fast economic development: academia, industry and the government. Research institutions and universities act as the main generators of knowledge and ideas, the industry actors as the main user of this knowledge, and the government, which is in the position to create a normative-regulatory framework for society, plays a vital role in creating the conditions for the successful cooperation of all three actors. From the perspective of time, we could describe the development of relations between all three key actors through three main periods (Viale and Etzkowicz 2002).

The first period covers the time up until the Industrial Revolution of the nineteenth century and defines the role of knowledge as the "controlled observation of our surroundings and economic production is a decisive act of transforming the observed reality with the special purpose of providing comfort, human desires and needs" (Kuznets 1965). Knowledge is the domain of individuals, thus the transferability of knowledge between actors can be challenging.

The period of industrial revolutions is described as a transition period from individual inventors to networks of entrepreneurial scientists. Freeman et al. (1982) describe this period from the beginning of capitalism to the theory of long waves, dividing this period into five parts/waves. These waves denote key changes in technology, social organization and related institutional changes. Most of the technology before 1850 (steam technology, looms and steel production) was engineered by their practitioners. Only a few achievements emerged from empirical models based on natural laws. Inventions largely founded largely based on the principle of experimental trial and error. The second Industrial Revolution was made possible with the breakthrough of natural laws.

The beginning of the Third Industrial Revolution was marked by great scientific discoveries such as nuclear energy, the discovery and development of semiconductors and antibiotics (Viale and Etzkowicz 2002). Here, industry's collaboration with science became very strong. The focus of cooperation comes from within the universities, with the support of industry actors. The reason for this is not a greater intensity of research, but the changing role and function of universities. There is a so-called "institutionalization of innovation" (Mowery and Rosenberg 1998). The strong role of the state in this process is reflected in the promotion, structuring and financing of these discoveries. The so-called entrepreneurial universities, in addition to science, also develop technologies and stimulate innovation. This industry, university or state-supported research and development work is characterized by a close link between science and technology.

The latest phase of the Third Industrial Revolution involves the enhanced integration of various emerging technologies (Roco and Bainbridge 2002). This integration not only means enhanced cooperation between science, the industry and the government, but also the enhanced global role of universities and the emergence of universities with a wide range of disciplines and scientists, which provides a window of opportunities to combine the knowledge from different disciplines, innovations and entrepreneurial models (National Science Foundation 2002).

However, the end of twentieth century brings radical changes in the production of knowledge, including new actors involved in the innovation process and knowledge production. Different theories describe these processes from different points of view.

2.2.1 Mode 2: Changing Mindsets on the Role of Science in the Innovation Process

The concept of Mode 2 was elaborated and presented by experts in the field of policy research (Gibbons et al. 1994). Mode 2 theory deals with the emergence of knowledge, in contrast to the traditional concept of knowledge related to scientific disciplines, in a far wider transdisciplinary social and economic process. The theory was prompted and developed in view of the major changes in science and higher education in the second half of the twentieth century. It redefined the role and place of universities in society. Within the framework of the theory, the authors describe different movements that emerged and developed during this period in the production of knowledge. The theory distinguishes between two distinct types of scientific production: Mode 1, characterized by the gap between research institutions and society, the self-definition and self-sufficiency of scientific disciplines and specialties, interactions between researchers and the economy almost does not exist. The second method, known as Mode 2, points to the disappearance of boundaries between scientific disciplines and self-control over the direction and content of the research (Gibbons et al. 1994; Shinn 2002; Nowotny et al. 2006).

The essence of the Mode 2 concept is the notion of a socially distributed creation of knowledge, which, unlike the traditional way of creating knowledge, was created primarily in academic institutions—in universities, institutes and laboratories, and was coined by Mode 1 as appearing in new places and in a new way. This new Mode 2, differs from the traditional model by virtue of the following characteristics (Gibbons et al. 1994):

- *Contextualization*. Knowledge is generated in the context of its use (which is also possible in Mode 1, but the formation and use of knowledge are strictly separated) (Gibbons et al. 1994).
- *Transdisciplinarity*. The term refers to the fact that the solution to problems in Mode 2 includes a wider range of theoretical and methodological approaches. The concept of transdisciplinarity goes beyond the concept of interdisciplinarity in that interactions between individual disciplines are far more dynamic. When a theoretical consensus is reached, it cannot be reduced to individual disciplines (Gibbons et al. 1994; Hessels and Van Lente 2008). The concept of transdisciplinarity enables different approaches to problem-solving, which encourages collaboration outside or beyond the boundaries of existing disciplines (Mali 2009).
- *Heterogeneity*. Knowledge generated in Mode 2 is created in different organizations. Knowledge is created not only in traditional academic institutions (universities, institutes and laboratories) but also in research centres, public agencies, high-tech "spin off" companies, consulting houses that are interconnected, and new knowledge is a product of mutual interactions (Gibbons et al. 1994).
- *Reflexivity*. Due to the inclusion of different approaches and disciplines, the knowledge gained in Mode 2 has the ability to integrate multiple views and

arise in the form of a dialogue. Researchers are increasingly aware of the social responsibility of their work and from the outset take into account the impact of the results of their research on society (Gibbons et al. 1994).
- *New forms of evaluation of research results* are the fifth characteristic of Mode 2 of knowledge generation. The traditional "peer review" system of knowledge verification limited to individual disciplines now came to include other criteria that take into account economic, political, social and cultural criteria. Evaluation is no longer restricted to specific judgments within individual scientific disciplines (Gibbons et al. 1994; Hessels and Van Lente 2008).

Concluding with the Mode 2 concept, we find that Mode 2 brings and entirely new view on the innovation process by introducing, as well as interdisciplinary, new forms of evaluation, which are far broader than classic evaluation schemes, framed with a single specific scientific discipline.

2.2.2 *Finalization of Science*

The concept of the "Finalization of science" describes and explains the dynamics of science and its social function. The concept originated in the 1970s, when a German group known as "Starnberger's" developed a research programme based on scientific dynamics consisting of the case studies of various scientific disciplines (Rip 1989).

The main conclusions of the research asserted that disciplines follow a general development in which we can distinguish an explanatory, paradigmatic and post-paradigm phase. In this context, the most important is the final stage in which "finalization" can occur. According to this concept, theoretical development, which is determined by external factors, can be understood. Further, more and more disciplines come to reach the final stage, which points us to the fact that the relationship between science and society is changing. In this relationship, the company is becoming an increasingly active partner and is taking on a role as a leading player (Hessels and Van Lente 2008).

Compared with Mode 2, four important differences are worth mentioning:

- The concept of "finalization" has strong empirical foundations based on several case studies (Böhme et al. 1983).
- The concept of "finalization" clearly distinguishes between scientific disciplines and treats them separately.
- Unlike the production of new knowledge in Mode 2, the finalization of science largely relates to internal causes and not to external ones.
- When it comes to "normative finalization", the concept of finishing science is highly prescriptive. It does not mention the growing social dimension and orientation of science, but makes recommendations to policymakers (Weingart 1997; Hessels and Van Lente 2008).

2.2.3 Post-normal Science: Introducing Public Participation

Post-normal science is referred to as the concept that arises from the problem of managing complex scientific problems, when confronted with a situation that traditional science avoids: uncertainty. Post-normal science accepts the legitimacy of a plurality of views and treats them as an integral part of science. This ensures a wider framework of cooperation in decision-making (Funtowicz and Ravetz 2003).

The concept derives from the solution of complex and acute (typically environmental) problems, as well as lessons about the limitations of a rational decision-making process. Such problems require a redefinition of the role of a scientific approach in solving them. In environmental discussions, "the facts are blurred, the bets are high, and the decisions necessary" (ibid.). Quick decisions are required, while there are many unknowns and expectations. We are confronted with various values that are involved in solving the problem. The usual methodological approach, which Funtowicz and Ravetz (2003) called normal science, deals with the problem of reducing a complex field to simpler building blocks that allow for controlled experiments. Such an approach is suitable for confirming abstract theories, but is not suitable for today's problem-oriented research (ibid.).

The essence of the concept lies in the fact that a required scientific practice, which can be confronted with uncertainty, a plurality of values and stakeholders with different interests, is required. As a supplement, therefore, it can support policymakers, taking into account their time constraints. For this purpose, the term "post-normal science" was conceived. Its most prominent characteristic is public participation, and is called the "extended peer community" (Funtowicz and Ravetz 1993). Despite the involvement of the public, however, advocates of this concept are often limited to the involvement of stakeholders and stakeholders only in the decision-making process or in assessing the quality of scientific production (Hessels and Van Lente 2008).

2.2.4 Triple Helix Model: Taking Roles Between the Players in the Innovation Process

The main factors influencing rapid economic development and the relations between the main actors of this development are also described by the Triple Helix model (Etzkowitz and Leydesdorf 2000), presented as the triple helix model of innovation. This model encompasses the interdependence of the three main players: academia, industry and the government at different points of capitalization of knowledge (Etzkowicz 2002). The idea of a Triple-helix model follows from the evolution of innovation systems and the conflict involved in choosing the path to be taken in terms of the relations between academia and industry. The model itself distinguishes a specific historical situation.

The Triple Helix model describes relations in three dimensions. The first dimension of the model describes the internal transformations in each of the helixes, such as business links, or the awareness of universities about their mission of economic development. In the second dimension, it describes the interaction between helixes, such as the role of the state. The third dimension is the state of overlapping of trilateral networks and organizations among all three helixes created with the aim of producing new ideas and forms of high technological development. The concept of a Triple Helix model defines its beginning as the moment when academia, industry and the government enter into a mutual relationship in which they strive to improve each other's work.

The concepts described here developed with accelerated globalization and the many global challenges of modern society, such as climate change and ageing populations.

2.2.5 Further Development of Innovation Concepts: The Public Becomes an Active Player in the Innovation Process

Further developments of the Triple Helix model led to the emergence of the quadruple or pentacle helix models of innovation. If the Triple Helix model describes the relationship between academia, industry and the government as the main players in the innovation process, the model of the Quadruple helix includes the helix of civil society (Carayannis et al. 2012). While the triple helix emphasizes the importance of innovative universities, the quadruple helix introduces the perspective of the knowledge society and the democratization of knowledge. Instead of the development of society in the knowledge economy introduced by the triple helix, the innovation of the quadruple helix system requires the simultaneous development of the knowledge economy, the knowledge society and the knowledge democracy. The concept of the quadruple helix encourages society and the democratization of knowledge to support, promote and accelerate the production of knowledge (research) and the use of knowledge (innovation) (Carayannis and Campbell 2012). The concept of the pentacle helix in the entire innovation process brings with it environmental sensitivity. "The Pentacle helix supports the creation of a state of mutual benefit between ecology, knowledge and innovation, and the creation of mutual positive effects between the economy, society and democracy" (Carayannis and Campbell 2012). As a practical example to which the concept of the pentacle helix can be applied, the authors point to the issue of climate change.

Simultaneously with the concept of the quadruple and the pentacle helix, the concept of Mode 3 knowledge emerged. The concept of Mode 3 emphasizes the coexistence and joint development of different modes of knowledge and innovation. Compared with Mode 2, it emphasizes pluralism and the diversity of knowledge and innovation. Pluralism supports the processes of mutual learning using different types

of knowledge, and thus enables the creation of various forms of integration between basic and applied research (Carayannis and Campbell 2012).

2.3 The Importance of Sustainable Innovation in the Innovation Process

Systemic thinking in innovation studies emphasizes the importance of interactions and feedback mechanisms among all innovation actors, including university researchers, industry developers, brokering organizations and end-users (Lipnik 2016). The concept is primarily used as a framework for describing and explaining the complexity of innovation systems, and is also used to propose a more systematic approach to innovation policies (Smits and Kuhlmann 2004).

The system is defined as a set of interconnected components that work towards a common goal and which consists of components, the relationships between them, and its attributes (Carlsson et al. 2002).

The perspective of the innovation system is used at different levels to describe the innovation system, but is linked to the consideration of the interactive nature of a successful innovation process (Edquist and Johnson 1997; Hessels and Van Lente 2008).

The 1990s marked the beginning of intense theoretical engagement with innovation processes and various innovation models. The traditional, linear model of innovation, the beginning of the innovation process was in basic research, which, through applied research and engineering development, transforms into a product/service. This process can operate on the basis of market pull or the suppression of science and is based on the first generation of innovation policies (Lipnik 2016).

In the 1990s, the traditional innovation model underwent changes with the emergence of a coupling model. The coupling model is a combination of both of the previously described models. The concept of the model asserts that research using new technologies and knowledge-based production, from below, as well as society and related market requirements, from above, have an effect on the realization of new products and services.

Innovation studies at the beginning of the twenty-first century brought in the concept of the "National Innovation System", which assigns a new role to both research and the market. These are seen not only as the main generators of the need for new products and services, but recognizes them as important actors in national economies—however, market need is still the main generator of innovation, together with other important factors such as fiscal policy, innovation support, promotion of entrepreneurship and mobility (Lipnik 2016). Under these conditions, however, through direct or indirect measures, the state is influenced through its institutions (Nabradi 2009; Kuret 2012; Lundvall 1988). The national innovation system (hereinafter NIS) is represent in Fig. 2.1.

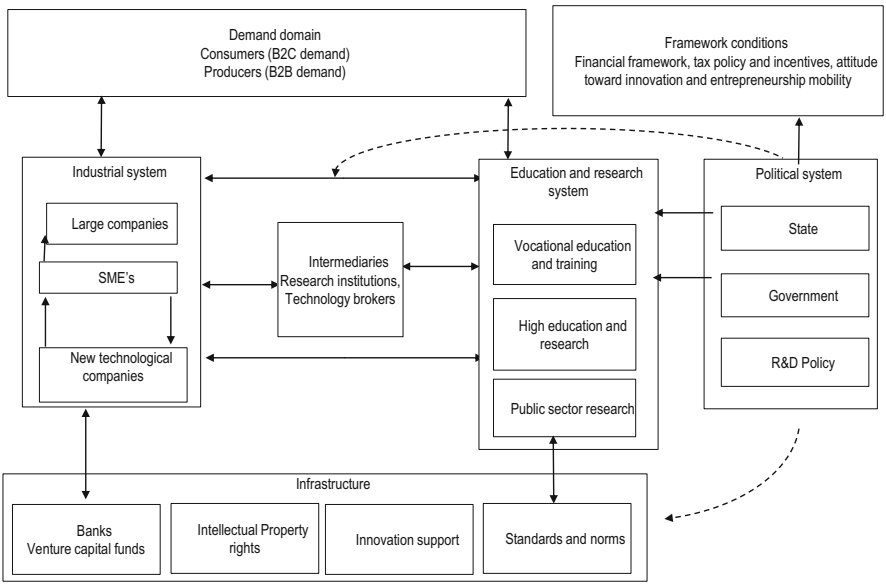

Fig. 2.1 National innovation system/scheme. Source: Kuhlmann and Arnold (2001)

An important change introduced by NIS is the conditions and incentives that the state determines in order for the innovation system to function properly and successfully (Chesbrough 2003).

Although the authors of the concept consider the national innovation system, individual authors argue that globalization, transnational connections, like the EU, and multinational corporations have, on the one hand, greatly diluted the role of the state in the innovation process; on the other hand, regional subsystems are becoming more important than the state, including individual regions, certain industrial quarters or "silicon valleys" (Freeman 2002).

Moreover, regional infrastructure, knowledge and skilled employees, specialized services, as well as mutual trust and personal connections play an important role on the regional level, and contribute much to the regional innovation system (Freeman 1995).

In this light, the authors distinguish between the narrower definition of NIS, which includes sources of innovation that have changed greatly over the centuries, from scientific academies in the seventeenth century, through the industrial revolution of the eighteenth century, to the growth of universities, scientific faculties and institutes. In the twentieth century, this narrower definition includes industrial research and the emergence of research councils, ministries of science and technology, as well as institutional networks (Lipnik 2016).

The broader concept of NIS understands that the sources of innovation are integrated into a far wider socio-economic system with a strong political and cultural impact on the innovation process; similarly, economic policy influences and to some

extent determines the extent, direction and success of innovation activity (Freeman 2002). However, recent developments show the need to transcend the concept of NIS in order to address the challenges of a larger global society. This approach shows the need for a "Transformative Innovation Policy", which divides innovation policies into three frames. Frame 1 refers to policies aimed at producing social benefits through R&D investment; Frame 2 refers to NIS; and Frame 3 is dedicated to the role of science, technology and innovation policy in the implementation of Global Sustainable Development goals, addressing questions related to global sustainability, poverty and inequitable income distribution (Schot and Steinmueller 2018). This concept does not ignore the importance of Frame 1 and Frame 2, but implies that both Frame 1 and Frame 2 have to be open to the emerging global challenges.

2.4 Definitions

2.4.1 Innovation

In any consideration of innovation systems, we are confronted with the concept of innovation. Waite (2014) pointed out that innovation is widely recognized as the main driver of industrial growth. Innovative companies achieve a competitive advantage, but the idea of a competitive national economy works to create a system that improves the competitiveness of the national economy as a whole. Countries try to achieve this by investing in innovation and, consequently, improving their own innovative ability (Porter 1990).

Mulej et al. (2008) suggest that innovation comes from an invention, which differs from it by the fact that someone has developed it to its point of utility, and that it has already found its customers and proved to be useful. Most innovations appear to build on "repurposing, improving or renewing existing ideas and practices" (Hines and Marin 2004).

According to OECD (2005), innovation is the use of a new or significantly improved product, service or process, new marketing or organizational methods, business practices, workplace organization or external relations. Innovation is the result of an innovation process, and this process can come about due to the demands of the market, users or scientific findings.

Charter and Clark (2007) point out that innovation is the successful exploitation and commercialization of new ideas. It is far more than the common perception that innovation is only about new ideas or research and development. Furthermore, they add that innovation can (ibid.):

- Cover all processes (technological, organizational and marketing) in the development and commercialization of novel products and services providing value to customers

- Occur at four main tiers or levels (technologies/products/services, process, organizational, business)
- Include, but is not limited to the ideas and research stages of the innovation cycle, or to novel technology alone, although these are core elements of innovation
- Include "low tech" and is not restricted to "high tech" technologies

The term innovation is often used interchangeably with other terms, such as a new or novel idea, radical change and creativity (Waite 2014). Creativity is considered in the generating of ideas as the front-end of the problem-solving process, while innovation is useful for implementing a solution as the back-end (Waples and Friedrich 2011).

2.4.2 Eco-innovation and Sustainable Innovation

There are several accepted definitions of eco-innovation. According to the European Commission (2007), eco-innovation is any form of innovation aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment or achieving a more efficient and responsible use of natural resources, including energy. Charter and Clark (2007) refer to eco-innovation as the creation of novel and competitively priced goods, processes, systems, services, and procedures designed to satisfy human needs and provide a better quality of life for all, with a minimal use of natural resources (materials, including energy and surface area) per unit output, and a minimal release of toxic substances. In general, these definitions emphasize that eco-innovations reduce the environmental impact that arises as a result of consumption and production activities, whether the primary motivation for their development or deployment is environmental or not (Carrillo Hermosilla et al. 2010). Eco-innovations can serve as relevant tool for wiring up the innovation system. They may contribute to the renovation of the whole innovation system, taking into account social, ecological and economic aspects. Thus, sustainability becomes a key driver of innovation (Carrillo Hermosilla et al. 2010). In recent years, sustainable innovation has been gaining increased attention from academia, industry and the government actors, but there is no precise or established definition of sustainable innovation, which reflects the more general difficulty in defining the concepts of sustainability and sustainable development (Charter and Clark 2007). Varadarajan (2015) pointed out that sustainable innovation is a company's implementation of a new product, process, practice or modification of an existing product, process or practice that significantly reduces the impact of the company's activities on the natural environment. Furthermore, Charter and Clark (2007) argue that just as with general innovation, there is an emerging sense of recognition that sustainable innovation involves not only new concepts but also the commercialization of technologies, products, services and entrepreneurship. It can also involve the adoption of new processes and systems at the societal level.

2.4.3 CASI-F Definition of Sustainable Innovation

One of the objectives of the CASI project was to develop a working definition of sustainable innovation. For this purpose, a comprehensive analysis of different SI principal actors was prepared using the quadruple helix approach. Principal actors involved in the process were environmental scholars, the European Commission (EC) environmentalists, sustainable innovators, citizens and Pan-European SI stakeholders. From the perspective of environmental scholars, the current definition of SI relates to innovations, which involve environmental improvements. These environmental improvements were addressed in a number of consecutive EU funded Framework programmes for R&D through different key actions, thematic priorities and societal challenges. In order to access SI innovation from innovators perspectives, over 500 SI initiatives were nominated and systematically mapped as part of the CASI project activities. EU citizens provided another source of SI perspectives as citizen panels organized in 12 EU countries identified 27 research priorities. Another rich source of SI perspectives in the CASI project was pan-European stakeholder consultations, conducted through stakeholders' workshops, policy dialogues, and via an online survey.

The analyzed results were used to construct the following definition of sustainable innovation: *"Sustainable innovation may be conceived as 'any incremental or radical change in the social, service, product, governance, organisational, system and marketing landscape that leads to positive environmental, economic and social transformations without compromising the needs, welfare and wellbeing of current and future generations"* (Popper et al. 2016a, b). This definition refers to seven types of innovations, which derived from a comprehensive desk research, and which served a framing purpose for the mapping and studying of SI initiatives in the CASI project (see Popper et al. 2017).

2.5 Environmental and Sustainable Challenges

Europe 2020, a strategy for smart, sustainable and inclusive growth sets policy priorities, which reflect global social challenges. Horizon 2020 (H2020), the EU's main financial research and innovation programme in the period 2014–2020 used this challenge-based approach by organizing its activities into the following seven Grand Societal Challenges (European Commission 2019):

- Health, demographic change and well-being
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy
- Secure, clean and efficient energy
- Smart, green and integrated transport
- Climate action, environment, resource efficiency and raw materials
- Europe in a changing world—inclusive, innovative and reflective societies
- Secure societies—protecting the freedom and security of Europe and its citizens

The CASI project focused on Grand Societal Challenge 5 (SC5), i.e. Climate action, environment, resource efficiency and raw materials, the objective of which is "*to achieve a resource—and water—efficient and climate change resilient economy and society, the protection and sustainable management of natural resources and ecosystems, and a sustainable supply and use of raw materials, in order to meet the needs of a growing global population within the sustainable limits of the planet's natural resources and eco-systems*". SC5 is explicitly addressed in H2020 work programmes for the years 2014–2015, 2016–2017 and 2018–2020 and promotes a systemic and holistic approach in relation to technology, business models and economic organization, finance, governance and regulation as well as skills and social innovation (European Commission 2015, 2017, 2018; see also Table 3.3 in Chap. 3).

On a global scale, in September 2015, the United Nations (UN) adopted the 2030 Agenda for Sustainable Development, including the following 17 Sustainable Development Goals (SDGs):

- Goal 1. End poverty in all its forms everywhere.
- Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
- Goal 3. Ensure healthy lives and promote well-being for all at all ages.
- Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
- Goal 5. Achieve gender equality and empower all women and girls.
- Goal 6. Ensure availability and sustainable management of water and sanitation for all.
- Goal 7 Ensure access to affordable, reliable, sustainable and modern energy for all.
- Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
- Goal 10. Reduce inequality within and among countries.
- Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.
- Goal 12. Ensure sustainable consumption and production patterns.
- Goal 13. Take urgent action to combat climate change and its impacts.
- Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
- Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
- Goal 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
- Goal 17. Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development.

These goals are strongly interconnected, thus achieving them, with the inclusion of multiple stakeholders, would provide a rather holistic solution to global challenges. For this reason, a multi-stakeholder forum was assembled in order to identify and examine technological needs and gaps, including scientific cooperation, innovation and capacity-building (UN 2015).

2.6 Conclusions

A panoramic review of the innovation concepts highlighted the growing interdependence between the main players of the innovation system; multidisciplinarity, where science becomes collective and the focus shifts from the emergence of new knowledge to the use of such knowledge; and that wider participation of all relevant stakeholders becomes increasingly important.

Tracing the development of the innovation process demonstrates the growing importance of sustainable innovation. Such importance was recognized by policymakers and became an important part of political agendas and research programmes internationally, as it became evident that global challenges could be successfully addressed only through coordinated action of multiple stakeholders.

The multi-dimensional nature of sustainability was identified and addressed in the CASI project. The CASI-F Framework (a.k.a. CASI-F, see Popper et al. 2017) entails a multilevel and multi-actor approach to assessment and management of sustainable innovation, thus contributing to increased understanding of SI practices, outcomes and players, and how these could contribute to setting, and addressing, important national and global priorities.

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Chapter 3
Types of Innovation for Sustainability: The Role of Social Innovations

Rick Hölsgens and Jürgen Schultze

Abstract After a brief introduction of the seven types of sustainable innovations (SI) identified in the CASI project, this chapter zooms in on the role of social innovations for sustainability. Building on examples from CASI and beyond, we conclude that social innovations can be important for the transition towards sustainability from two angles. Firstly, social innovations aim at altering social practices. As such, many sustainable social innovation initiatives persuade individuals to change their (consumption) practices. Secondly, social innovation can also concern novel ways of working and collaborating. In this role, socially innovative initiatives can contribute to the transition towards sustainability by introducing new methods of co-creation and consensus-based innovation, as well as of planning and policymaking that lead to more sustainable product, practices and services.

3.1 Introduction

The transition towards sustainability represents a complex challenge. It is clear that, in order to keep global warming within the 1.5, or even 2, degrees Celsius, a myriad of production and consumption practices must change. The Headline Statement issued by the Intergovernmental Panel on Climate Change (IPCC) in their special report on 'the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways' summarizes the required action as 'Limiting the risks from global warming of 1.5 °C in the context of sustainable development and poverty eradication implies system transitions that can be enabled by an increase of adaptation and mitigation investments, policy instruments, the acceleration of technological innovation and behaviour changes' (IPCC 2018).

There are two important elements in this claim that deserve attention. The first is that the transition requires systemic change. This means, innovativeness is required

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throughout the entire system, and is therefore not restricted to technological change only. Systemic change also requires new practices of consumption and collaboration. The second important aspect touched upon relates to types of action that are identified. The IPCC stresses a need for investments in adaptation and mitigation (i.e. targeting economic decision-making), policy instruments (i.e. calling for political interventions and strong policies), the acceleration of technological innovation (i.e. product and production innovations) and behavioural change (i.e. innovations in consumption practices).

In a study of sustainability innovations, as undertaken in the EU funded CASI project,[1] it was necessary not to restrict the analysis to technological innovations alone. The CASI project identified seven different types of innovations that are all required for, and can contribute to, the transition to sustainability.

After a brief introduction of all seven types of sustainable innovation (Sect. 3.2), this chapter focuses specifically on social innovations (Sect. 3.3). Social innovations primarily target innovative social practices, i.e. novel social practices (behaviours) and their intentional change. Although the topic of social innovation is booming (both in academia and politics), when talking about sustainable innovations, one tends to primarily think of technological innovations such as the electric cars or renewable energy. However, practice change is, as we will argue more extensively below, of imminent importance as well. Willett et al. (2019), for instance, have recently argued that in order to ensure a sustainable future, people's food consumption practices have to be drastically altered. Although these authors are more concerned about the technical feasibility of feeding a growing world population with a sustainable and healthy diet, it is clear that the potential success—i.e. widespread implementation—of this diet is solely dependent on people's willingness to change their eating habits. This example illustrates the necessity of systemic change, as innovativeness is required across the entire chain from production to consumption. It also illustrates that solving the technical challenges is insufficient. People's behaviour and practices have to change as well. Social change and social innovation, therefore, play a key role in the transition to sustainability.

Building on examples of sustainable social innovations from the CASI project and beyond, in this chapter, we argue that there is a dual role of social innovations that should be considered in addressing sustainability challenges. The first, and arguably most straightforward, relates to the needs to change production and consumption patterns. The second role of social innovations in sustainability transitions relates to novel forms of collaboration, or 'multi-stakeholder governance'. As it is becoming more and more commonly accepted in governance practice and literature, sustainability and climate change adaptation/mitigation governance requires the inclusion of a broad variety of stakeholders in order to find broadly supported and accepted solutions to complex challenges. This, as such, is a novel social practice, but it also asks for novel approaches to steer these multi-stakeholder engagement processes. Both roles of social innovations for sustainability will be addressed in this chapter.

[1]Grant agreement number 612113.

3.2 Seven Types of Innovation

For several decades, innovation has been equated with technological change and the economic benefits resulting from these technological innovations. In recent years, however, a broader appreciation of the concept of innovation has emerged. Innovation scholars such as Godin (2015) have traced back the history of the concept of innovation and show that early understandings of the concept had a social rather than a technological connotation; and that it actually had negative associations. One of the founding fathers of modern innovation research, Joseph Schumpeter, also had a broader understanding of the term, as is being pointed out regularly by modern innovation scholars (e.g. Godin 2015; Howaldt and Schwarz 2019). Even though Schumpeter's approach was almost purely economical, Howaldt and Schwarz (2019) challenged him (alongside Georg Simmel, Max Weber and Gabriel Tarde) for not working out the concept of social innovation any further.

The EU 7th Framework Programme's project—CASI—developed its own definition of sustainable innovation. It included seven types of innovations, which have been identified for the purpose of a comprehensive mapping exercise, the results of which confirmed that the transition to sustainability does not only require technological change, but also social, organizational and governance innovations. The seven types of innovations studied within the CASI project include (see also Popper et al. 2016 and Chap. 1):

- Product innovation
- Service innovation
- Organizational innovation
- Marketing innovation
- Governance innovation
- Social innovation
- System innovation

The first four were based on the OECD *Oslo Manual* (2005), with the remark that the third edition of the Oslo Manual does not explicitly lists service innovations. Instead it provides a separate category for process innovations, which, within the CASI project, have been included under either product innovations or under service innovations, depending on the focal point of the process change. The categories of social innovation and system innovation were derived from The Young Foundation (2012), whereas the category of governance innovation was added based on Hartley (2005).

With this broad understanding of types of innovations for sustainability at hand, the CASI project partners set out to map exemplary SI initiatives from EU28, and beyond.[2] This effort resulted in a total collection of over 500 sustainable innovation case studies. The cases were nominated by the project consortium members based on

[2]For a full overview of project partners see: http://www.futuresdiamond.com/casi2020/about/team/ (last accessed 10 January 2019).

predefined assessment criteria, and mapped in the CASI bank of SI initiatives, known as CASIPEDIA (http://www.futuresdiamond.com/casi2020/casipedia/cases/[3]).

The numerical distribution of the different types of sustainable innovations that have been mapped is, as such, not completely representative. Nonetheless, it may not be surprising that product and service innovations top the board, collectively amounting to 58% of all cases mapped (Popper et al. 2016). With 75 out of a total of 549 cases mapped, social innovations were the third biggest category with almost 14% of the total.[4]

As noted by Popper et al. (2016) in their 'State-of-the-art of Sustainable Innovation', classifying sustainable innovations under these categories can be challenging, and sometimes rather arbitrary. Many sustainable innovations can be labelled under more than one type of innovation, which was addressed by allowing the selection of one main type, as well as additional supporting types, of SI. However, some minor classification issues were encountered. The case of Repair Café (Belgium), for instance, has been mapped in CASIPEDIA as a governance innovation (main type), while social innovation was selected as supporting type.[5] The Austrian Reparatur-und Service-Zentrum R.U.S.Z., which also provides repair services for household appliances, was categorized primarily as service innovation, with additional supporting innovation being that of organizational innovation.[6] This is somehow surprising since repair cafés, and the 'maker movement' that surrounds them, are oftentimes recognized as prime examples of social innovations. The digital mapping of social innovation initiatives as part of the Atlas of Social Innovation created in the SI-Drive project,[7] for instance, contains over a dozen initiatives that are related to 'repairing' (including R.U.S.Z.).[8]

The pilot applications of the 'Common Framework for Assessment and Management of Sustainable Innovation', known as the CASI-F (Popper et al. 2017), made a distinction between technical and social innovations.[9] In the analyses of these pilot applications, for which a total of 45 cases from the CASIPEDIA were selected, both the Belgian Repair Café and the Austrian R.U.S.Z. were nominated as social innovations (Schultze et al. 2016). However, even with the basic classification of

[3]Last accessed 10 January 2019.

[4]Numbers extracted from Popper et al. (2016). After the publication of this report it was still possible for consortium members to add additional cases; also, not all cases have been made publically available in CASIPEDIA as data may have been incomplete or sensitive.

[5]See http://www.futuresdiamond.com/casi2020/casipedia/cases/repair-caf/ (last accessed 10 January 2019).

[6]See http://www.futuresdiamond.com/casi2020/casipedia/cases/reparatur-und-service-zentrum-r-u-s-z/ (last accessed 10 January 2019).

[7]See https://www.si-drive.eu/ (last accessed 21 December 2018); SI-Drive, Social Innovation—Driving Force of Social Change was funded under the EU seventh Framework Programme; and mapped over 1000 cases of social innovations (see Howaldt et al. 2016).

[8]See https://www.socialinnovationatlas.net/map/ (last accessed 19 December 2018).

[9]For a more elaborated description of the CASI-F, see Chap. 1.

social versus technical innovations, 10 out of 45 cases nominated for the pilot study were labelled as both, technological and social. Ten innovations were exclusively technological and 25 were social. Including the ten SI cases classified as social and technological, 78% of the studied cases were thus social innovations in one way or another. The cases were selected from the CASIPEDIA database with the aim of representing a large spread of cases covering 'success factors' (technological, economic, environmental, political, social, ethical and spatial/urban) and 'scale of innovation (ranging from slight improvement to existing product, service, etc. to new product, service, etc. that creates dramatic change and transforms markets or industries) (Schultze et al. 2016). Regardless of the size of the selection, it is sufficient to underline the importance of social innovations for sustainability and to demonstrate that social innovations (i.e. changes in social practices) play a key role in sustainable innovations that may be predominantly service, organizational, or any other type of sustainable innovation.

3.3 Social Innovation

Although all seven types of sustainable innovations have their relevance for the transition towards sustainability, which requires systemic change and therefore innovativeness in multiple areas, this chapter will focus, in particular, on the role of social innovation for sustainability. Schot and Steinmueller (2018) sketch a history of innovation policy since the Second World War and identify three 'frames' of innovation policy. The first framing is characterized as 'innovation for growth' and emerged after WWII. The second framing emerged in the 1980s and centred on the concept of 'national systems of innovation'. It drew the idea of innovation policy away from innovation for the global good to national systems including national networks and knowledge structure. Although the focus of innovation *policy* (Schot and Steinmueller's main concern in their paper) shifted, the main purpose of *innovation* remained more or less the same: economic growth through scientific and technological progress. The resulting economic developments (at least in the western world and, more recently, Asia) have been impressive; GDP per capita increased more than threefold between 1950 and 2000 in the United Kingdom and the United States, while the German GDP per capita increased sixfold in this period and the Japanese GDP per capita in 2000 was over 12.5 times as large as it was in 1950 (Bolt et al. 2018). However, as it is well-recognized nowadays, these developments came at considerable environmental costs.

To cope with modern day challenges related to sustainability, Schot and Steinmueller (2018) claim that these 'old' framings are not sufficient. Schot and Steinmueller, therefore, call for a new framing that addresses 'transformative change'. Transformative change requires (socio-technological) system changes that go beyond technological innovations. Although the authors mention the concept of social innovation only once in their paper, their analysis of the types of changes that are required, highlights the necessity of changing social practices. Alongside the

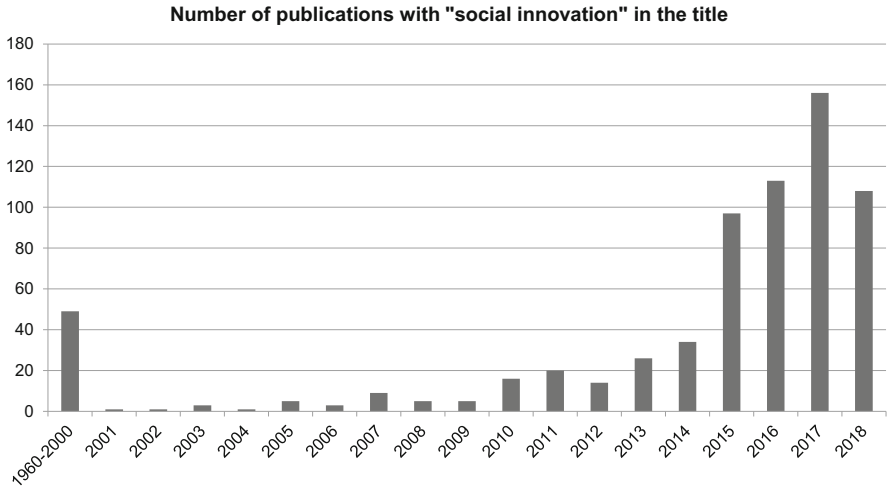

Fig. 3.1 Number of publications with 'social innovation' in the title. Source: Web of Science (10 September May 2019, note that the number of publications for the most recent years may not be complete yet due to publication delays)

other types of innovation, social innovation appears to be of imminent importance for sustainability and sustainable development (Millard 2018; Schultze et al. 2015); not least because, as we elaborate below, social innovation has a dual role in sustainability transitions.

3.3.1 Defining Social Innovation

Before we inquire deeper into the importance of social innovation for sustainability, we shall define the concept first. Despite early references to social innovation and social change as central part of innovation (see Godin 2015; Howaldt and Schwarz 2019; Mumford 2002), the concept of social innovation in its modern day understanding is relatively recent; as apparent from basic quantitative assessment of the presence of social innovation in scientific publications (see Fig. 3.1). In a social constructivist view, one might say that there still is a lot of interpretative flexibility surrounding the concept. This flexibility helps to move the (academic) field forward, but it can also give rise to confusion. At the same time, though, Ayob et al. (2016) observe first signs of closure. Various understandings of social innovation nonetheless still exist alongside each other and across different disciplines (see Rüede and Lurtz 2012; Van der Have and Rubalcaba 2016).

Without further investigation into the different views, it is fair to say that a minimal distinction should be made between normative and non-normative approaches to social innovation. The normative approach to social innovation includes expectations of social innovation as solving modern-day societal

challenges. These normative expectations can be seen, for instance, in the approaches of the Bureau of European Policy Advisors (BEPA 2011) or The Young Foundation (2012), and are brought to the point in a popular quote, by then EU President, Barroso in 2012: 'Social innovation is not a panacea but if encouraged and valued, it can bring immediate solutions to the pressing social issues citizens are confronted with' (quoted in Hubert 2012). The closure observed by Ayob et al. (2016) also leans towards this normative interpretation.

The (academic) question of the *how*, i.e. how these social innovations function, grow, diffuse, lead to durable change, etc., tends to be reduced in these normative approaches, to what skills and resources the innovators need in order to successfully diffuse their novel ideas and practices. To get a deeper understanding of the dynamics of social innovation, it is necessary to let go of the normative interpretations though. Social innovation is than understood rather as an analytical concept (e.g. Howaldt and Schwarz 2019).

Approached as an analytical concept for sociological studies, social innovation refers to innovations in which the locus of the innovation can, above anything, be found in the social realm and in social practices and behaviour. Social innovation is then about changing social practices. We, therefore, are inclined to follow the definition by Howaldt and Schwarz (2010), which demarcates social innovation as an intentional new combination or configuration of social practices in certain areas of social action, prompted by certain actors or constellations of actors with the ultimate goal of coping better with needs and problems than is possible by using existing practices (Howaldt and Schwarz 2010).

Following this definition, social practices may change for better or for worse, and what is desired by one actor group may be discarded by another. The social innovation may therefore also have detrimental effects on the environment or other social groups; see, for example, the analysis of the Canadian Indian Residential Schools by McGowan (2017). As long as a deliberate change in social practice can be observed, one can speak of a social innovation in a sociological analytical sense. This objective and rational approach is vital to the study of dynamics of social change and social innovation.

Also in connection with the highly normative goals of sustainability, such an objective approach to social innovation is paramount, for at least two reasons. Firstly, because it is first and foremost necessary to understand the complete dynamics of social innovation diffusion before it is possible to apply these insights to the normative goals of sustainability. That is, before one can speak about the sustainability potential of a social innovation, one first needs to understand the dynamics and potentials of changing social practices (towards sustainability) (see also Chap. 8 by Hölsgens). Secondly, innovations may always have negative side effects or lead to unexpected and unwanted rebound effects and too high normative expectations of social innovations may lead to a myopic view.

Having said so, it is obvious that the socially innovative initiatives mapped within the CASI project aim to be sustainable and thus have normative objectives. This does not interfere with the study of these sustainable social innovations, as innovations in

which the locus of change is primarily a change of practice, the fact that the envisioned change of practice aims at sustainability is of secondary importance.

Having defined social innovation as changes in social practices, the 'social' part of the concept has been explained. This leaves us with the challenge of defining 'innovation'. Also here we do not wish to open up a debate that exceeds the scope of this chapter, but two issues shall be addressed. The first is the relative novelty of the innovation. How radically new does the change of practice, put forward by a social innovation, need to be in order to earn the status of innovation? With regards to technological or product innovation one may maintain that something that is patentable can be classified as an invention, that can (potentially) become an innovation. However, for social innovations there are no patenting offices assessing the novelty of an initiative. Although we do believe the term social innovation can be overused at times, leading to inflation and a devaluation of the concept, social practice changes in our understanding do not have to be radically new to constitute a social innovation. The practice has to be different and set itself apart from the mainstream practice that has been in place at the time of the occurrence of the social innovation. This means, for instance, that a practice that was common in the past, but has come out of fashion since, can now again constitute a social innovation. Likewise, a practice that is well-established in one location can be a social innovation elsewhere. Thirdly, also a practice that has long been present within a small niche, and that 'suddenly' spreads over wider groups of society can be considered a social innovation.

The second question we have to address is the 'size' of the innovation. When is something merely a local initiative (analogue, perhaps, to a technological invention before diffusion) and when can a change of practice indeed be called a social innovation? This question is even more complex than the previous. Does a certain minimum share of the population have to adopt the novel practice before we can call it a social innovation? Or can a social innovation also be called an innovation when it only survives in a small niche of society? And should a local initiative that barely got started be called a social innovation, simply because it targets a change of practice? Or should it have 'proven' itself for a certain period first? And if a small-scale local initiative classifies as a social innovation, are larger scale societal trends such as vegetarianism, flexitarianism and veganism also social innovations? And how about societal revolutions?

Although we believe the term social innovation is sometimes applied too quickly to, what could be more accurately called socially innovative initiatives, we consider a wide range of 'scales' of social innovation, as was also commonly done in CASIPEDIA on which we rely here. As the CASI project focused on collecting identifiable initiatives, meaning there is some kind of organization behind the sustainable innovation, larger scale societal trends such as the zero-waste movement are excluded. At the same time, though, a concrete project aiming at reducing waste,

such as the 'Content' store by 'Leuven pakt uit' ('Leuven unpacks') is included as sustainable social innovation in CASI and in our analysis.[10]

3.4 Social Innovations and Sustainability: A Dual Role

Having defined social innovations as deliberate changes in social practices, we observe a dual role for social innovation in sustainability transitions. On the one hand, and this is most prominent in the cases collected within CASI (but also in other European projects on social innovation such as SI-Drive or TRANSIT[11]) various sustainable social innovation initiatives aim directly at changing people's practices towards sustainability. Examples include the aforementioned repair cafés, but also more abstract notions such as vegetarianism or veganism. However, on the other hand, social innovations can also play a role as novel social practices to develop sustainable innovations in 'multi-stakeholder governance' processes. The resulting innovations can be more technical in nature, but the process of development of these sustainable innovations rests on socially innovative methods in novel collaborative settings. Examples of this kind of social innovation for sustainability include innovative stakeholder participation methods, social simulations or participative roadmapping to collaboratively agree on a path towards sustainability. To make the transition to a more sustainable future, both roles play a decisive role; both will be discussed in detail below.

3.4.1 Social Innovation as Sustainable Practice Change

The transition to a more sustainable future requires changes of social practice. These changing social practices may go hand in hand with technological progress, but technological change alone will not be sufficient. Regardless of the question whether technological improvements in all relevant (i.e. polluting and resource intensive) industries will be fast enough to make the transition to sustainability, one issue, in particular, will limit its effectiveness: the so-called *rebound effect*. It is well documented that a reduction of costs for the individual product or service usually does not lead to overall reduction because the savings are used to purchase more (see for instance Fouquet and Pearson 2006). Social practices of energy use, mobility and food consumption will have to change in order to become sustainable.

[10] See: http://www.futuresdiamond.com/casi2020/casipedia/cases/content/ (last accessed 30 January 2019).

[11] http://www.transitsocialinnovation.eu/ (last accessed 10 January 2019). TRANSIT, Transformative Social Innovation Theory was funded under the EU seventh Framework Programme; TRANSIT focused on social innovation networks and studied 20 international social innovation networks.

As mentioned before, within the CASI project, many examples of sustainable social innovations were mapped, including innovations for which 'social innovation' was selected as 'additional supporting innovation' and those selected as social rather than (or as well as) technological in the piloting of the CASI-F Framework (see Martin and Avarello 2016; Schultze et al. 2016; Popper et al. 2016, 2017). Because of the nature of the case selection, virtually all of the sustainable social innovations mapped in CASIPEDIA correspond with the first role of social innovation: for all initiatives, the primary target is a novel practice and/or persuasion of others to change their practice in accordance with the goals of the SI. As a result, within the role of 'social innovation as sustainable practice change' two approaches should be separated. The first concerns direct novel social practices of those involved (for instance in repair cafés); the second concerns persuasion (often through education) of others to change their practices in a sustainable manner. In the latter category, the first category may also be featured, when novel methods/practices are explored in an attempt to leave a longer lasting impact on the target group. Both approaches will be shortly addressed by means of two examples from the CASIPEDIA database.

The first example of a sustainable social innovation that involves a novel social practice can be found in the Finnish case of 'Cleaning Day—Siivouspäivä'. As presented in CASIPEDIA, 'Cleaning Day is a day of celebration for friends of flea markets and recycling, which changes Finnish cities and neighbourhoods into huge flea markets and marketplaces. The idea of Cleaning Day is to make recycling easy and create vivid and responsible urban culture. Anyone can offer their second-hand items up for sale on the streets, yards and at home, as well as make the best finds of the day. Cleaning Day does not have an official organizer; all participants are organizers of their own events. Everyone is responsible for cleaning up after themselves.'[12] Although there is no formal organizer of the Cleaning Day, it is supported by the non-profit organization Yhteismaa. In this example, those participating in the initiative, instead of throwing away old items and buying new, buy and sell second-hand products, thus avoiding waste. The initiative also aims to change the 'urban culture' by bringing people together, and creating a new culture (i.e. new practices) of recycling.

A second example of a sustainable social innovation that involves a novel social practice is the German initiative 'Stromsparcheck'.[13] Stromsparcheck aims to contribute to two prominent challenges at the same time: that of long-term unemployment and that of carbon dioxide emissions. Stromsparcheck has become a nation-wide project, carried locally be organizations such as Caritas. The aim of the project is to help poorer households to save electricity and therewith—from the perspective of the household—money and—from the perspective of the wider society—CO_2 emissions. In order to achieve this objective, these households receive

[12] http://www.futuresdiamond.com/casi2020/casipedia/cases/cleaning-day-siivouspiv/ (last accessed 1 February 2019).

[13] http://www.futuresdiamond.com/casi2020/casipedia/cases/stromsparcheck/ (last accessed 1 February 2019).

free information and advice by a specially trained advisor. This advisor is usually a person that has been unemployed for a long time and therefore has limited opportunities in the labour market. By providing these long-term unemployed people with specific training, they are provided a chance to work and to, potentially, enter the labour market. This social innovation, therefore, changes social practices from two sides. The first is bringing long-term unemployed back in the labour market, and the second is the change in energy consumption patterns, as being taught to the households.

A central element of Stromsparcheck is thus the information provided to the households, as such, it could be argued that, at least part of its target is to persuade people to change their behaviour. However, by going into the households, providing them with more sustainable technologies (worth up to 70 euros per household), and directly informing the inhabitants about what they can do to live a more sustainable lifestyle, Stromsparcheck sets itself apart from initiatives that try to persuade people to change their practices from a more abstract and distanced position. Examples of social innovations that take this more distanced, indirect, approach based on awareness raising, education and information, are the Lithuanian awareness-raising blog 'Ekorekomendacijos.lt' and the Bulgarian '3D Ecobus—Mobile Education Center'.

Ekorekomendacijos.lt[14] (Eco-recommendations) is the first example of a social innovation aimed at persuading people to change their social practices. Eco-recommendations started in 2009 with a goal to increase the number of consumers with responsible behaviour. Following its slogan: 'Prove that you have the strength to not only change, but also contribute to significant changes. Small things create great ones. Everyone has power of significant changes'[15] Ekorekomendacijos.lt aims to persuade the general public of the need to change practices to reduce the environmental impacts of consumption. The website provides information about environmental issues to increase knowledge and awareness, and it aims to develop willingness of consumers to contribute to combatting environmental problems through, and in, everyday behaviour. By providing weekly advices on issues related to home, work, food, or driving, a broad set of themes are addressed under the assertion that everyone's behaviour may contribute (also in small steps) to substantial positive changes in an environmentally friendly way. In contrast to the SI initiative of the abovementioned Finnish 'Cleaning Day—Siivouspäivä' and German 'Stromsparcheck', Ekorekomendacijos.lt does not directly involve a change of social practice, but aims to contribute to changing social practices in an indirect way through awareness raising and education.

[14]http://www.futuresdiamond.com/casi2020/casipedia/cases/awarenes-blog-ekorekomendacijos-lt-eco-recomendations/, http://www.ekorekomendacijos.lt/blogas/, regretfully, the blog does not list any entrances past November 2017, the Facebook page related to the initiative (https://www.facebook.com/ekorekomendacijos/) has been active at least until September 2018 (all websites last accessed 7 February 2019).

[15]http://www.futuresdiamond.com/casi2020/casipedia/cases/awarenes-blog-ekorekomendacijos-lt-eco-recomendations/ (last accessed 7 February 2019).

The Bulgarian '3D Ecobus—Mobile Education Center'[16] provides us with another example of a socially innovative initiative for sustainability which aims to achieve practice change through education. The 3D Ecobus is a mobile information-education center that makes use of state-of-the-art (3D) technology to inform about the importance of sustainable behaviour. Interestingly, the project addresses a wide range of target groups, ranging from primary school pupils to company employees and government institutions. 3D Ecobus' purpose, as described in CASIPEDIA, is 'to enrich the knowledge [of the children and grownups] about the separate collection of waste and the benefits for the environment and society, to build sustainable positive attitude towards the process of selective collection and to encourage the creation of sustainable habits for participation in it.'[17]

As demonstrated in these four initiatives, sustainable social innovations that aim to change practice towards more sustainable behaviour can be very diverse. An important distinction made in this section is concerned with whether the social innovation directly involves a change of practice, or whether it merely aims to persuade people to change their behaviour through awareness raising, education and information. They can also vary in size, target group, approach and ambitions. At the same time, the cases collected within the CASI project show that such diverse socially innovative initiatives can be found all across Europe.[18]

Despite this diversity though, it is necessary to separate another distinct role for social innovations. Beyond directly or indirectly aiming to change social practices, social innovations can also play a role for sustainability transitions by establishing new practices to collaboratively develop sustainable solutions. The next section deals with this second 'role' of social innovation for sustainability.

3.4.2 Social Innovation as Innovative Method to Find Sustainable Solutions

Social Innovation, in its second role, characterizes a new path of 'producing' innovation. The innovation process is becoming more and more of a crossover cooperation between different stakeholders representing different stakeholder groups. The in-depth analysis of 43 pilot cases mapped in the CASI project resulted in a fundus of actions, which are seen as success elements from the perspective of the innovators. One of the most common action areas covered 'collaboration,

[16] http://www.futuresdiamond.com/casi2020/casipedia/cases/3d-ecobus-mobile-education-center/ (last accessed 7 February 2019).

[17] http://www.futuresdiamond.com/casi2020/casipedia/cases/3d-ecobus-mobile-education-center/ (last accessed 7 February 2019).

[18] Compare also with SI-Drive, which mapped over 1000 cases of innovative initiatives (not necessarily sustainable) world-wide (see https://www.si-drive.eu/, last accessed 21 December 2018).

cooperation, engagement in multi-stakeholder dialogues and networking'. This conclusion was addressed as the basis for an effective and efficient social innovation process (Schultze et al. 2016).

These empirical findings correspond with the above-described complexity of sustainability challenges. The interdependencies touch a plurality of affected stakeholders. Furthermore, sustainable innovations are more likely to be effective and broadly accepted when developed by more than one institution or stakeholder group. The success of sustainable innovations requires the ideas, competence and support of diverse actors from all stakeholder groups of the quadruple helix.

This new way of producing innovation is underlined by the empirical research on social innovation from the recent years. The conclusions of the large mapping exercise of SI-Drive and the CASI project highlight the importance of multi-stakeholder constellations in the broad range of social innovation. Especially with an eye on the complex systemic changes required for the transition to a sustainable economy, the integration of different stakeholder in the innovation process is paramount. One selected case from CASIPEDIA, supplemented with another examples, illustrates this second role of social innovation.

The Italian Open Innovation Hub on Peri-Urban Agriculture aims to create a 'strategy and operating as a living lab to foster innovation in the entrepreneurial, social, sustainable and technological dimensions of the agri-food sector'.[19] The self-conception as 'The Urban Lab Europe' opens up new ways of innovation generation. The municipality of Milan gives the input of its own food policy, targeting a sustainable food system to deliver healthy food to all, traditional entrepreneurs and start-up could meet to create new solutions and citizens are inspired to participate in the innovation process. These lab activities are framed by basic trainings, identification of innovation streams, using ICT platform for exchange of information/ideas in order to develop a peri-urban agrifood sector, create attractiveness of investments, and to follow innovations in the area. The hub aspired to become an exemplary model of peri-urban integration for other cities, as a new way of producing innovation.

Another example of the second role of social innovations is the roadmapping approach used to develop and implement climate change adaptation measures. By bringing together a wide-range of relevant stakeholders, and engaging them in a discussion on visions for the future of their region, the roadmapping approach has enabled local and regional discussions that exceeded debates on competing interests in the here and now. Instead, by collaboratively developing a vision for the future, it has proven possible to bring together stakeholders with competing interests. After agreeing on a vision for the future, concrete measures, linked to a concrete timeline, can be more easily agreed upon. Even though the developed measures may be rather technological in nature, the process can be described as socially innovative since it builds on alternative practices of stakeholder consultation and collaboration. This

[19] http://www.futuresdiamond.com/casi2020/casipedia/cases/11752 (last accessed 9 September 2019).

socially innovative method was mapped in the SI-Drive project, and it was nominated as an exemplary social innovation (see Schartinger et al. 2017).

3.5 Conclusions

Following an introduction of different types of innovations this chapter highlighted the role and importance of social innovation for addressing sustainability challenges. To make the transition to sustainability, a change of production and consumption patterns is needed. This includes the intentional change of social practices, or, in other words social innovation. The transition towards sustainability represents a complex challenge that demands system shifts, which cannot be achieved by technological innovations alone, but that needs the change of social practices.

As presented in the chapter, the CASI project mapped a plethora of different socially innovative initiatives from across Europe, which underlines the relevance of social innovation in the practical implementation of transition elements. Classifying innovations as social can be challenging, as even sustainable innovations that have clear elements of service or organization innovations, can oftentimes also be considered social innovation because they involve a deliberative change of social practices.

We juxtaposed two distinct roles for sustainable social innovations. The first role concerns the introduction of new sustainable social practices. The majority of the social innovations mapped in CASIPEDIA play this role. These initiatives aim to change social practices; either directly by introducing more sustainable practices to their target groups, or indirectly, through awareness raising, education and information. These initiatives do not directly introduce new practices for their target groups, but aim to persuade people to change practices in their daily lives.

The second role of social innovation concerns the introduction of novel social (usually collaborative) practices to develop sustainable innovations. In this role, the socially innovative initiatives do not primarily aim at introducing sustainable practices, but at more effective processes for the development of sustainable innovations. These processes involve novel ways of collaborating and integrating stakeholders. With these novel practices, sustainable innovations can be developed and implemented with a broader support. These innovations can, but do not necessarily have to be, social innovations.

In both roles, social innovations can contribute towards the transition to sustainability. On the one hand by directly transforming unsustainable social practices into sustainable social practices, and on the other hand by changing the practice of ‘producing’ sustainable innovations. Through collaborative and socially innovative processes, potential conflicts among stakeholders can be overcome, resulting in more effective sustainable innovations.

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Part II
Participatory Governance of Sustainable Innovation

Chapter 4
Exploring the Role of Stakeholder Engagement for the Development of Sustainable Innovation Strategies

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Abstract This chapter aims to explore how configurations of stakeholder engagement influence the generation of sustainable innovations (SIs). More specifically, by assessing a sample of agro-food Italian companies, the study contributes to (1) identifying different SI strategies and (2) exploring the role of cultural and managerial attributes related to stakeholder engagement in supporting the development of SI strategies. A cluster analysis was conducted on a sample of 72 companies in Italy, revealing the existence of three bundles, each characterized by differences in the degree and types of SI. A variance analysis of business practices among the three clusters highlights the critical role played by stakeholder engagement in supporting the development of SI strategies.

4.1 Introduction

Emerging socioeconomic pressures, environmental problems, and transformative technologies make sustainability important for innovation. Sustainability pressures drive companies to rethink their products, processes, relationships, and business models in order to achieve competitive advantages in terms of cost-efficiency or sustainable value differentiation, compete in a transforming business environment, and make their contributions to sustainable development (Seebode et al. 2012; Nidumolu et al. 2009).

Generally, a sustainable innovation (SI) is conceived as an innovative solution aimed at improving long-term environmental, social, and/or economic performance (Ketata et al. 2015; Juntunen et al. 2018). More specifically, in this book, SI is defined as *"any incremental or radical change in the social, service, product,*

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governance, organisational, system and marketing landscape that leads to positive environmental, economic and social transformations without compromising the needs, welfare and wellbeing of current and future generations" (Popper et al. 2016, see also Chaps. 1 and 2).

The management of SI can be particularly challenging for companies due to its multidimensional nature and purposes (Ketata et al. 2015; Seebode et al. 2012). Indeed, SI is widely recognized as more complex than traditional innovation by the requirement to integrate diverse resources, knowledge, and problem-solving approaches relating to economic, environmental, and social issues (Adams et al. 2016; Hansen et al. 2009; Iñigo and Albareda 2016; Ketata et al. 2015). Previous studies identified some specific practices to manage the complexity of SI (e.g., Ayuso et al. 2011; Hansen et al. 2009; Kazadi et al. 2016; Ketata et al. 2015; Mousavi and Bossink 2017). In particular, the integration of the sustainability purposes into a clear innovation strategy is important for recognizing and taking advantage of opportunities for SI generation (Amui et al. 2017; Mousavi and Bossink 2017). Firms need innovation strategy to clarify objectives and priorities, to align innovation efforts with their corporate strategies and among various groups of stakeholders (Pisano 2015). SI is increasingly acknowledged as a result of strategies and activities that are collaborative and open to solution co-creation with various stakeholders who are sources of inspiration and knowledge (Iñigo and Albareda 2016; Goodman et al. 2017; Juntunen et al. 2018; Kazadi et al. 2016). Thus, the literature on SI management suggests that dialog, involvement, and collaboration with various stakeholders are essential ingredients for developing successful SI (e.g., Goodman et al. 2017; Juntunen et al. 2018).

However, studies focused on the role of collaborative stakeholder engagement in the development of SI strategies are scarce (Goodman et al. 2017). There is a little understanding of how companies manage collaboration with stakeholders, especially the interplay of business practices that can influence the development of SI strategies (Juntunen et al. 2018).

This chapter aims to explore the role of stakeholder engagement for the development of SI strategies. The literature on open and collaborative innovation among different stakeholders identifies conditions for successfully involving stakeholders in SI strategy, but more research that adopts a collaborative perspective on stakeholder relationships is needed (Goodman et al. 2017). This study builds on the CASI-F Framework for the assessment and management of SI (Popper et al. 2017) and analyzes the stakeholder engagement of a sample of agro-food Italian companies. The study contributes to (1) identifying different SI strategies and (2) exploring the role of cultural and managerial practices related to stakeholder engagement in supporting the development of SI strategies.

Some practices have been studied that relate to the management of stakeholders' relationships, including the choices of types and number of involved stakeholder groups and the use of collaboration tools (Juntunen et al. 2018). Moreover, different practices related to Corporate Social Responsibility (CSR) aim to integrate social and environmental issues into business activities and improve relationships with stakeholders. The empirical study presented in this chapter focuses on agro-food

sector, which was selected due to its relevance for both the Italian economy and the achievement of the 2030 Sustainable Development Goals concerning poverty, hunger, climate change, and natural resources.

The chapter is structured as follows. The topic of SI strategies at company level is introduced, followed by a literature review highlighting the potential role of different CSR practices and tools for collaboration with stakeholders for the development of SI strategies. Next, the methodology used for data collection and analysis is illustrated. The main results of the study are then presented. One noteworthy result is the existence of a critical relationship between the adoption of proactive SI strategies and activities for engaging and collaborating with different stakeholders. The chapter concludes by discussing this and other findings.

4.2 Theoretical Framework

4.2.1 A Classification of SI Strategies

A review of SI literature revealed a scarcity of studies on SI strategies. However, some studies do explore the deep connection between corporate strategy and the implementation of SI initiatives (e.g., Adams et al. 2016; Berkhout 2014; Bos-Brouwers 2010; Klewitz and Hansen 2014). Indeed, the level and success of SI depend on the degree of integration of sustainability issues into a clear and overall corporate strategy (Amui et al. 2017). Thus, this study considers both the large literature on corporate sustainability strategies and the literature on the strategic management of SI.

The corporate sustainability strategies concern the integration and embedding of sustainability into the core strategic goals of the firms (Baumgartner and Ebner 2010; Berkhout 2014). Various models describe the transition toward corporate sustainability strategies. These models converge on the idea that firms can move from a defensive to a proactive strategic approach (e.g., Baumgartner and Ebner 2010; Buysse and Verbeke 2003; Bos-Brouwers 2010; Dunphy 2011; Klewitz and Hansen 2014; Schaltegger et al. 2012). It is possible to highlight three main strategic approaches to sustainability. First, the *defensive or compliance-oriented strategy* is employed by companies that consider sustainability as a risk. These companies do not really innovate for sustainability purposes, and when they do implement sustainable changes, it is only to comply with regulation or meet external certifications and standards requirements. Second, the *cost-effectiveness strategy* is adopted by companies that consider sustainability issues linked to the internal changes for achieving cost reductions and increased efficiency. These companies alter their processes for cost savings through innovation aiming at smart and efficient use of resources. Third, the *proactive strategy* emerges when companies see sustainability as a key opportunity for competing in the market and contributing to sustainable development.

The proactive strategy seeks to achieve sustainable value creation through product and service innovation. A more proactive strategic approach to sustainability can contribute to sustainable business model innovations to achieve long-term economic, social, and environmental performance (Klewitz and Hansen 2014; Schaltegger et al. 2012). When firms develop a more proactive strategic approach, they become more aware of and concerned about their environmental and social impacts, and thus they improve the integration of sustainability into their innovation strategies, and transform their business activities (Adams et al. 2016; Baumgartner and Ebner 2010; Dunphy 2011; Schaltegger et al. 2012). The evolution of corporate strategies toward a proactive strategic approach increases the SI opportunities for processes, products, services, and entire business models (Klewitz and Hansen 2014; Schaltegger et al. 2012).

The literature also reveals that some *reactive companies* entirely ignore or refuse to engage on environmental and social issues. Reactive companies do not innovate on sustainability. Some researchers have observed that firms with a proactive strategic approach show more SI activities and achieve better triple-p performance (people, planet, and profit) that integrates economic, social, and environmental issues. Firms with a compliance-oriented strategy are hardly innovative because they limit innovation to what they must do (Bos-Brouwers 2010; Schaltegger et al. 2012).

Thus, the review of the literature reveals a connection between corporate sustainability strategies and the strategic choices a firm makes regarding its SI activities. In this chapter, SI strategies are defined by strategic decisions firms made regarding types and degree of SI introduced. In particular, SI strategies are understood as the integration of sustainability into products and/or processes innovation that generate business model innovations changing how businesses create and deliver value to and with their stakeholders.

4.2.2 Stakeholder Engagement as a Potential Driver of SI Strategies

The barriers and drivers of SI are a topic of interest for both academics and practitioners in the SI field. Although previous research has focused on this topic, there is a need to better explore which factors lead to more proactive SI strategies (Iñigo and Albareda 2016).

Through analyzing the literature in the SI field, it is possible to identify external and internal factors that can drive or inhibit SI (e.g., Ketata et al. 2015; Przychodzen and Przychodzen 2018; Doran and Ryan 2016). The external factors of the business environment include the institutional and socioeconomic characteristics of the local context and of the industry sector, sustainability-related public policies, environmental regulations, pressures of social and environmental movements, and consumer demand for sustainable products and production processes (e.g., Bossle et al. 2016;

Doran and Ryan 2016; Ketata et al. 2015; Klewitz and Hansen 2014; Przychodzen and Przychodzen 2018). There is increasing research interest in understanding the internal factors that can influence and foster a company's SI. Internal factors include the company's cultural factors like values and norms that influence CSR (Altenburger 2018; Bocquet et al. 2013; MacGregor and Fontrodona 2008; Martinez-Conesa et al. 2017), sustainability orientation and organizational culture, and the motivation and values of owners/managers (Bos-Brouwers 2010; Fellnhofer 2017). Internal factors also include organizational factors like the size of a company, its level of internationalization, and its position in the value chain (Klewitz and Hansen 2014; Przychodzen and Przychodzen 2018; Doran and Ryan 2016). Other important internal factors include managerial practices and abilities at the firm or individual levels, such as stakeholder engagement, knowledge management, human resource management, communication, sustainable accountability, environmental management, the manager's skills and visionary leadership, and strategic attitude (e.g., Ayuso et al. 2011; Bossle et al. 2016; Klewitz and Hansen 2014; Fellnhofer 2017).

Stakeholder engagement is widely recognized as a leading factor in the development of innovation, particularly for successful SI (Ayuso et al. 2011; Buysse and Verbeke 2003; Goodman et al. 2017; Watson et al. 2018). A stakeholder is defined as *"any group or individual who can affect or be affected by the achievement of the organization's objectives*" (Freeman 1984). Stakeholder engagement can be understood in a broad sense as the positive interaction and/or involvement of stakeholders in the activities of an organization (Greenwood 2007). These activities include the company's innovation processes and strategies (Goodman et al. 2017; Juntunen et al. 2018).

According to traditional stakeholder theory, SI needs to consider many disparate stakeholders who advance their different, and often contradictory, demands (Hall and Vredenburg 2003). Debates about the role of stakeholders for SI originally focused on different stakeholder pressures and managing stakeholder expectations about controversial issues (Goodman et al. 2017). More recent studies adopt a collaborative perspective on stakeholder theory and explore engaging stakeholders as sources of inspiration and knowledge for SI (e.g., Goodman et al. 2017; Juntunen et al. 2018; Kazadi et al. 2016).

Innovation has undergone evolutionary steps from the traditional paradigm of closed innovation to new paradigms like open innovation (Chesbrough 2003), user innovation (Von Hippel 2009), open collaborative innovation (Baldwin and Von Hippel 2011), and co-innovation (Lee et al. 2012). All these paradigms converge on the idea that no firm can innovate alone but need to engage with a wide range of stakeholders to gather ideas and resources beyond its boundaries. This can help the firm to sustain a competitive advantage and face the complex challenges of a rapidly changing environment (Altenburger 2018).

SI is increasingly conceived as a collaborative effort, more customer-oriented, and more open to knowledge co-creation than traditional innovation (Adams et al. 2016; Goodman et al. 2017; Ketata et al. 2015; Iñigo and Albareda 2016). SI is an open innovation because it requires a more open approach to knowledge

management and innovation processes, involving various internal and external actors as sources of new ideas and knowledge (Chesbrough 2003). SI is collaborative innovation because it is a result of multi-stakeholder engagement effort, in which the firm facilitates the active involvement of stakeholders and the sharing of ideas, knowledge, experiences, competences, and opportunities (Goodman et al. 2017; Ketchen Jr et al. 2007).

Different empirical studies have shown manifold benefits of involving and collaborating with stakeholders in SI. The integration of different voices and perspectives in the innovation process facilitates better understanding of the firm's local context, including social needs and natural environmental problems and the anticipation of market opportunities in a dynamic business environment characterized by rapid changes (Ayuso et al. 2006, 2011). By developing mutual and trusting relationships with stakeholders, firms compensate their lack of resources with access to new and complementary sources of information and knowledge to support SI (Adams et al. 2012; Bos-Brouwers 2010; Kazadi et al. 2016). From a creative point of view, the involvement of committed internal and external stakeholders may enhance the firm's problem-solving capacity and generate new innovative solutions that benefit both the firm and its stakeholders and contribute to sustainable development (Ayuso et al. 2006, 2011; Bos-Brouwers 2010). Moreover, the collaboration with stakeholders helps companies to achieve shared goals and develop common criteria for assessing SI strategies, and thus enhancing the organization's legitimacy (Achterkamp and Vos 2006; Adams et al. 2016; Desai 2018).

The literature has also identified some disadvantages that make stakeholder engagement challenging for companies. Engaging with stakeholders requires resources and time. Each company should identify the groups of stakeholders that are relevant for developing SI in order to avoid spending excessive time and resources on interacting with stakeholders with little to contribute to their innovation processes (Kazadi et al. 2016). Moreover, the engagement of many stakeholders in SI processes is rarely conflict-free because various stakeholders often have different competing values and frames: they may interpret the same situation differently, and tensions may arise (Goodman et al. 2017; Hall and Vredenburg 2003; Watson et al. 2018). When the firm is unable to manage and solve conflicts between stakeholders, stakeholder diversity may slow down or impede decision-making (Ayuso et al. 2006; Juntunen et al. 2018). The integration of stakeholders may not foster SI if the firm lacks capabilities to collaborate with stakeholders and absorb the knowledge and resources located in diverse stakeholder groups (Ayuso et al. 2011; Kazadi et al. 2016).

The recent literature focuses on the dynamic capabilities for stakeholder dialog and engagement in SI (Ayuso et al. 2011) or environmental innovation (Watson et al. 2018) and for knowledge creation among multiple actors in the innovation processes (Kazadi et al. 2016; Ingenbleek and Dentoni 2016). Although the advantages and disadvantages related to stakeholder engagement in the SI field are known, the issue of how companies can effectively engage stakeholders remains underexplored (Ayuso et al. 2011; Goodman et al. 2017; Juntunen et al. 2018). Thus, this chapter aims to better comprehend the relationship between SI strategies and stakeholder

engagement. For this purpose, the chapter focuses on different configurations of business practices and tools that describe cultural or managerial attributes related to how companies engage their stakeholders.

4.2.3 *Managerial and Cultural Attributes of Stakeholder Engagement*

Existing studies of stakeholder engagement and SI consider the number and types of stakeholders involved, as well as the quality of organizational engagement (Juntunen et al. 2018). The stakeholders categorized as primary stakeholders are directly involved in economic transactions with the firm and are essential for its existence (e.g., shareholders, employees, customers, and suppliers). Secondary stakeholders are not directly involved in economic transactions but can play an important role in the organization's credibility and legitimization (such as CSOs/activists, communities, governments, academic institutions, and competitors) (Clarkson 1995). Previous research in the SI field has focused on the engagement of primary stakeholders (e.g., employee commitment, customer engagement, or the involvement of supply chain members). However, the role of secondary stakeholders is potentially more relevant than that of primary stakeholders in leading SI (Goodman et al. 2017; Hall and Vredenburg 2003; Ingenbleek and Dentoni 2016). Encompassing economic, social, and environmental issues in a long-term view, SI needs to consider a wider range of both primary and secondary stakeholders (Ayuso et al. 2011; Hall and Vredenburg 2003; Goodman et al. 2017).

Once the stakeholders have been identified, the firm needs to decide how to manage its relationships with stakeholders using a set of mechanisms, tools, and CSR practices that aim to create and maintain fruitful relationships (Greenwood 2007; Juntunen et al. 2018). As mentioned above, initial studies about the role of stakeholders in the sustainability field have embraced the traditional approach of stakeholder engagement for mitigating risks related to stakeholders' conflicting demands and different degrees of influence over the firm. This approach considers stakeholders as a source of risk and suggests controlling and managing stakeholders through monitoring and communication, including listening to stakeholders' concerns and informing them about corporate objectives, activities, and performance (Sloan 2009).

However, the traditional approach to stakeholder engagement seems to be less effective in the SI field because it leads to passive involvement that reduces opportunities for effective organizational changes and innovation (Sloan 2009). Open and collaborative innovation suggests a different approach based on dialog, involvement, and collaboration with various stakeholders recognized as potential sources of knowledge and ideas for SI (see Ayuso et al. 2011; Goodman et al. 2017; Kazadi et al. 2016). This collaborative approach to stakeholder engagement is argued to be more effective because it stimulates innovation and transformational

changes (Sloan 2009). It is consistent with responsible stakeholder engagement by enabling cooperation in mutually beneficial relationships (Greenwood 2007).

Firms can use different tools to interact and collaborate with various stakeholders (e.g., online consultation, dedicated listening lines, and focus groups or workshops). These instruments range from simple activities aimed at collecting stakeholders' suggestions during decision-making processes (Goodman et al. 2017; Luyet et al. 2012) to more active and creative involvement that needs to be structured and facilitated by the innovators (Goodman et al. 2017; Piller et al. 2011). Following the collaborative approach, stakeholder engagement should be considered as an effective managerial practice to collect, integrate, and produce new information and knowledge as a critical component of successful SI.

These instruments represent the concrete operationalization of stakeholder engagement and thus help to explain how firms manage their stakeholder relationships in practice (Ayuso et al. 2011; Steurer et al. 2005). However, to discuss the role of stakeholder engagement for the development of SI strategies, it is important to consider the adoption of CSR practices that help to explain relationships between the company and its multiple stakeholders.

According to its early formulations, CSR goes beyond the firm's economic and legal obligations and encompasses society's ethical and philanthropic expectations of the company (Carroll 1979). Over the past 40 years, the CSR concept has evolved and been progressively linked to the study of stakeholder engagement (e.g., Branco and Rodrigues 2007; Carroll 2015; Greenwood 2007; O'Riordan and Fairbrass 2014). A later formulation views CSR as "*the responsibility of enterprises for their impacts on society*" that requires "*close collaboration with their stakeholders with the aim of maximising the creation of shared value for their owners/shareholders and for their other stakeholders and society at large; identifying, preventing and mitigating their possible adverse impacts*" (EU Commission 2011).

Thus, the CSR concept emphasizes the motivations and responsibilities that drive a company to act in the interests of and engage with legitimate primary and secondary stakeholders.

Some authors distinguish different CSR culture profiles with respect to stakeholder engagement and the co-creation of value: (1) a compliance culture, where the company overlooks the engagement of stakeholders; (2) an instrumental relationship management culture, where the company recognizes the instrumental value of the engagement of immediate stakeholders; and (3) a sustainable organization culture, where the company collaborates with a variety of stakeholders to maximize the creation of value in economic, social, and environmental terms (Wheeler et al. 2003).

Many studies have emphasized CSR practices as potential drivers for SI, but the results of studies about the relation between social responsibility and the level of innovativeness are inconsistent (Mithani 2017; Martinez-Conesa et al. 2017). CSR is considered as a good proxy of moral motivations or cultural issues that underlie stakeholder engagement, as it concerns values, beliefs, and assumptions that can drive a firm toward better integration of sustainability issues, together with better engagement of both primary and secondary stakeholders in business activities (Greenwood 2007; Steurer et al. 2005; Wheeler et al. 2003). Therefore, in this

chapter, CSR will be measured by considering the implementation of various CSR practices that may help to create and maintain good relationships with various stakeholders.

Companies can develop a formal and well-integrated CSR system or undertake different practices associated with social and environmental responsibilities (e.g., social and environmental reports, use of renewable resources, reductions of emissions, treatment of women and minorities, etc.). The role of sustainable accountability is also emphasized by CSR studies as important to establish and maintain transparent and open communication with stakeholders (Lim and Greenwood 2017), as well as to foster awareness of sustainable actions and collaboration for SI (August 2018). In this sense, sustainable accountability is a means by which stakeholders can participate in company activities. The most common and widespread type of sustainability communication is to promote externally the company's social and sustainability efforts through external certifications that independently confirm the firm has improved its processes. These standard certifications may also be used inside the firm as a guide to continually improve and innovate processes. Moreover, firms can implement their own systems to assess the environmental and social impacts of their efforts. For this chapter, the adoption of various CSR practices is considered to indicate an organizational culture that focuses on the creation of value with stakeholders in economic, social, and environmental terms (Wheeler et al. 2003).

4.3 An Empirical Study in the Agro-Food Sector

4.3.1 Data Collection and Analysis

As a partner in the CASI project, the authors of this chapter decided in 2015 to extend previous research conducted within the EU project by focusing on agro-food clusters in Italy. Starting from prior evidence that emerged from the case mapped in CASIPEDIA (2017) and building on the CASI-F (see Popper et al. 2017 and Chap. 1), a study was conducted to explore the status and potential of companies within the agro-food clusters to support the sustainable development challenge.

The reference population was identified from the AIDA BureauVan Dijk database, from which a sample of 1470 companies was extracted of firms belonging to "agriculture," "food industry," and "large retail." Smaller companies (those with an annual turnover of less than 20 million euros), were excluded from the sample, as their choices and behavior might be quite specific, thus reducing their comparability with larger companies.

An online questionnaire was administered between June and July 2015 to 1108 companies and targeted to people who deal with issues related to sustainable innovation and CSR in each company. Building on CASI-F, the questionnaire was structured in three sections that identified SIs introduced by the company and the business practices adopted with reference to CSR and stakeholder engagement.

Seventy-two completed questionnaires were collected from external relations managers, marketing and communication managers, quality managers, human resource managers, deputy directors, and/or entrepreneurs. The final sample included 54 (75%) "food industry" companies, 13 (18.1%) "agriculture" companies, and 5 (6.9%) "large retail" companies. Thirty-six companies (50%) had between 50 and 249 employees, 21 between 10 and 50 (29.2%), and 15 had more than 249 employees (20.8%) at the time of the interviews. More than 70% of the companies in the sample were located in northern Italy (47.2% in the northeast and 23.6% in northwest), while 12.5% were in the center (12.5%) and 16.6% in the south or on the islands.

The full list of variables considered in this study is presented below:

- *Clustering variables.* Respondents were asked to list all SIs, defined as any change in products and/or processes introduced in the last 3 years which had an impact on environmental and/or social performance, both inside and outside the company. Answers were then grouped by the authors and the final set included 12 macro-types, as reported in Table 4.1. Each variable practice was then coded as a dummy variable, where 1 = introduced (in the last 3 years), and 0 = otherwise. Table 4.1 lists the types of SI.
- *Companies' structural characteristics.* A dummy variable was created for each of the four national local areas where the company operates (northwest, northeast, center, and south and islands) and the three industries they belong to (agriculture, food production, and large retail). Organization size was measured by the total number of employees. Responses were coded as categorical variables, where 1 = small (less than 50 employees), 2 = medium (between 50 and 249 employees), and 3 = large (250 employees or more). For the scope of the study, a dummy variable was created for each size category, where 1 = yes, and 0 = otherwise.
- *Corporate social responsibility (CSR).* Respondents were asked if their company had introduced a complete CSR system. Responses were then coded as a dummy variable, where 1 = introduced, and 0 = otherwise. The questionnaire also included questions to understand which models, guidelines, and tools were used by companies to improve their image among stakeholders and direct their choices toward greater social, environmental, and ethical responsibility. Whether each company had a social report, renewable resources, management of environmental impact, and social marketing was analyzed, and responses were coded as dummy variables for each tool, where 1 = used, and 0 = otherwise.
- *Indirect sustainable accountability.* Respondents were also asked about the adoption of certifications and standards, distinguishing between quality standards (ISO 9000), environmental certifications (ISO 14000; EMAS; 5000), social certifications (SA 8000; OHSAS; ISO 18001; SGSL; UNI-INAIL; ISO 26000; Q-RES), and sectoral certifications (IFS; BRC; ISO 22000). A dummy variable was created for each type of certification, where 1 = used, and 0 = otherwise.
- *Direct sustainable accountability.* Respondents were asked to specify if their company used measures for monitoring and assessing the environmental and

Table 4.1 Results of the hierarchical cluster analysis

Innovation		Cluster				
Type of innovation		Conservatives	Optimizers	Anticipators	Total	Sign.
Product	Organic/recyclable products	15.1% ($n = 5$)	26.3% ($n = 5$)	70.0% ($n = 14$)	33.3% ($n = 24$)	0.000
Product	Nontoxic/hypoallergenic products	6.0% ($n = 2$)	42.1% ($n = 8$)	30.0% ($n = 6$)	22.2% ($n = 16$)	0.006
Product	Reduction of product' packaging	24.2% ($n = 8$)	42.1% ($n = 8$)	100% ($n = 20$)	50.0% ($n = 36$)	0.000
Product	Replacement of polluting components with low environmental impact raw materials (e.g., replacement of soft lights with LEDs)	27.2% ($n = 9$)	26.3% ($n = 5$)	85.0% ($n = 17$)	43.1% ($n = 31$)	0.000
Process	Optimization of resource management in the production process by purchasing from social enterprises and non-profit organizations	0.0% ($n = 0$)	5.2% ($n = 1$)	20.0% ($n = 4$)	6.9% ($n = 5$)	0.019
Process	Optimization of resource management in the production process by using zero-kilometer suppliers	3.0% ($n = 1$)	78.9% ($n = 15$)	15.0% ($n = 3$)	26.4% ($n = 19$)	0.000
Process	Optimization of resource management in the production process by recycling and reusing raw materials	12.1% ($n = 4$)	63.1% ($n = 12$)	75.0% ($n = 15$)	43.1% ($n = 31$)	0.000
Process	Optimization of resource management in the production process by using renewable energy sources	42.4% ($n = 14$)	78.9% ($n = 15$)	80.0% ($n = 16$)	62.5% ($n = 45$)	0.004
Process	Reorganization of the production process to support employees' work–life balance	6.0% ($n = 2$)	47.3% ($n = 9$)	40.0% ($n = 8$)	26.4% ($n = 19$)	0.001
Process	Introduction of eco-compatible technology to reduce energy consumption, waste and atmospheric pollution	24.2% ($n = 8$)	84.2% ($n = 16$)	85.0% ($n = 17$)	56.9% ($n = 41$)	0.000
Process	Introduction of eco-compatible technology to dematerialize information (reduction of paper and toner waste)	30.3% ($n = 10$)	68.4% ($n = 13$)	70.0% ($n = 14$)	51.4% ($n = 37$)	0.004
Process	Packaging reduction in the distribution process	6.0% ($n = 2$)	10.5% ($n = 2$)	70.0% ($n = 14$)	25.0% ($n = 18$)	0.000
No. of companies		33	19	20	72	

Note: For each cluster, the percentage of companies that have introduced a specific SI is shown, with the number in brackets: for example, the number of firms that have introduced organic products (product innovation) is 14 in the "Anticipator" cluster, compared to 5 firms in both the "Optimizer" and "Conservative" clusters

social impact of businesses practices. According to the answers, two dummy variables were derived, one for environmental assessment and one for social assessment, where 1 = used, and 0 = otherwise.

- *Stakeholder engagement and collaboration.* Respondents were asked to indicate which type of stakeholders were engaged in the company's business activities distinguishing four main groups: employees, clients, providers, and local community actors (government, NGO, civil society, etc.). A dummy variable was created for each stakeholder group, where 1 = engaged, and 0 = otherwise. An ordinal variable was derived by considering the number of stakeholder groups involved by the company. Respondents were asked to indicate whether they used the following tools for interacting and collaborating with different stakeholders: online consultation, dedicated listening lines, and focus groups/workshops. A dummy variable was created for each of the tools, where 1 = used, and 0 = otherwise.

To verify the existence of different SI strategies within the companies of the agro-food clusters, a hierarchical cluster analysis was carried out following the methodological instructions provided by Ketchen and Shook (1996). Ward's method and Euclidean distance were used to identify clusters and similarities between models. The data were processed with IBM Statistics SPSS 25 software.

Three clusters were identified as the best solution, using the criteria of size and interpretability of the clusters (considering the significance of each clustering variable). To test the validity of the three clusters solution, contingency tables were developed by matching variables used for classification together with the identified clusters. The results of the contingency analysis confirm that the three clusters vary significantly according to the clustering variables used.

To identify the differences between the three groups in terms of companies' structural characteristics and their business practices, different tests for variance were performed. More specifically, the Pearson Chi-Square has been considered for categorical variables, while the one-way ANOVA was used for ordinal variables, and two significance levels were considered: 99% ($p < 0.01$) and 95% ($p < 0.05$).

4.3.2 Types of SI Strategies

The results of the cluster analysis are shown in Table 4.1. As already stated, data analysis identified three different clusters of companies according to the type of SI introduced, distinguishing three main SI strategies. The three clusters were then labelled as "conservatives," "optimizers," and "anticipators." The respective percentages do not sum to 100% due to the presence of deviating cluster members. As further explained below, the three clusters offer empirical evidence of different inactive, active, or proactive SI strategies, and these strategies resemble the defensive strategy, cost-effectiveness strategy, and proactive strategy found in the analysis

of previous studies in this field (e.g., Bos-Brouwers 2010; Klewitz and Hansen 2014; Schaltegger et al. 2012).

- Companies that adopt a "*conservative*" strategy are those that innovate little (or not at all) regarding sustainability, not having foreseen significant changes in this direction for products offered on the market or for production processes. Within this cluster, 6.0% of companies have introduced nontoxic/hypoallergenic products, 15.1% have invested in organic/recyclable products, while a slightly higher percentage have reduced product packaging and/or replaced polluting components of products with low-environmental-impact raw materials (24.2% and 27.2%, respectively). Low percentages also emerged when considering the list of process innovations. Interestingly, the optimization of resource management in production processes by using renewable energy sources is quite widespread within conservative companies (42.4% have introduced this innovation), although most in this group have not yet innovated their production process in the sustainable direction.
- Companies that belong to the group of "*optimizers*" are those that have almost exclusively introduced process innovations. These companies have invested considerably in the optimization of resource management in the production process through the use of zero-kilometer suppliers and/or the use of renewable energy sources (78.9%, respectively) and even in the recycling and reuse of raw material (63.1%). Particularly relevant is the number of companies that have invested in eco-compatible technology for reducing energy consumption, waste, and atmospheric pollution (84.2%), and/or in technologies for dematerialization of information (68.4%). While "optimizers" tend to innovate on processes, they do not innovate on products. Although relatively large percentages of companies within this group have introduced nontoxic/hypoallergenic products and/or reduced product packaging (42.1% respectively), most of them have not changed their products to make them more sustainable.
- Companies in the "*anticipators*" group have innovated their products and processes toward sustainability. With regard to product innovations, all companies have reduced packaging, 85% have replaced polluting components with ones of less environmental impact, and 70% have introduced organic and recyclable products. "Anticipators" have also innovated their production processes toward sustainability by reusing raw materials (75%), introducing renewable energy sources (80%), adopting eco-compatible technology for reducing energy consumption, produced waste, and atmospheric pollution (85%), and dematerializing information or reducing products' packaging (70%). Finally, 70% of the companies in this group have improved the sustainability of their distribution processes by modifying packaging of products.

Table 4.2 shows that no significant differences emerge between companies of the three strategic groups regarding their industries (agriculture, food production, and large retail), organization size (small, medium, and large), and location (northwest, northeast, center, and south and islands) ($p > 0.05$). Indeed, the distribution of

Table 4.2 Structural characteristics: means, standard deviations, and variance analysis

	Clusters (b)			Total	*p*-value (a)
	Conservatives	Optimizers	Anticipators		
Industry sector					
Agriculture	21.2% (0.6)	21.1% (0.5)	5.0% (−1.3)	16.7%	0.257
Production	69.7% (−0.4)	73.7% (−0.1)	85.0% (0.5)	75.0%	0.454
Large retail	6.1% (−0.2)	5.3% (−0.3)	10.0% (0.5)	6.9%	0.814
Size					
Small	30.3% (0.1)	36.8% (0,6)	20.0% (−0.8)	29.2%	0.503
Medium	51.5% (0.1)	42.1% (0.5)	55.0% (−0.3)	50.0%	0.703
Large	18.2% (−0.3)	21.1% (0.0)	25.0% (0.4)	20.8%	0.839
Location					
Northwest	21.2% (−0.3)	26.3% (0.1)	25.0% (0.2)	23.6%	0.903
Northeast	51.5% (0.4)	52.6% (0.3)	35.0% (−0.8)	47.2%	0.435
Center	12.1% (−0.1)	10.5% (−0.2)	15.0% (0.3)	12.5%	0.911
South and Islands	15.2% (−0.2)	10.5% (−0.7)	25.0% (0.9)	16.7%	0.456
No. of companies	33	19	20	72	

Note: Pearson's Chi-square test (for dummy variables) was conducted to analyze differences between the clusters. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$
For dummy variables, each cell includes the percentage of companies in each cluster and the value of the standardized residuals (in parentheses)

companies within the three strategic bundles is quite similar in terms of structural characteristics.

4.3.3 Stakeholder Engagement and Collaboration

Table 4.3 shows that the adoption of a complete CSR system is slightly more common among "optimizers" and "anticipators." However, and counterintuitively, the adoption of a CSR system does not significantly discriminate companies within the three strategic groups ($p < 0.05$).

"Anticipators" and "optimizers" make greater use of tools for managing indirect sustainable accountability, unlike companies who have not introduced SIs. Most "optimizers" and "anticipators" make use of renewable resources (73.7% and 90.0%, respectively) or adopt tools for managing their environmental impacts (84.2% and 80.0%, respectively), compared to just over half of "conservatives" ($p < 0.05$). Conversely, drawing up a social report and/or dealing with social marketing initiatives to influence the behaviors of specific target groups are not widespread in all strategic groups.

The practice of adopting certifications and standards attesting to the company's commitment to respect the environment and ensure the quality of agro-food products is quite diffused among all three strategic groups. The only exception concerns the Quality Management Standard (ISO 9000) that typically outlines the requirements a

Table 4.3 CSR and sustainable accountability, means, standard deviations, and variance analysis

	Clusters (b)			Total	*p*-value (a)
	Conservative	Optimizer	Anticipator		
Corporate social responsibility					
CSR system	33.3% (−0.4)	26.3% (−0.8)	55.0% (1.3)	37.5%	0.144
Social report	27.3% (0.4)	5.3% (−1.6)	35.0% (1.0)	23.6%	0.073
Use of renewable resources	54.5% (−1.0)	73.7% (0.2)	90.0% (1.1)	69.4%	0.022∗
Management of environmental impact	54.5% (−1.0)	84.2% (0.8)	80.0% (0.6)	69.4%	0.040∗
Social marketing	27.3% (0.1)	15.8% (−0.9)	35.0% (0.7)	26.4%	0.391
Indirect sustainable accountability					
Quality certifications	51.5% (−1.1)	73.7% (0.4)	85.0% (1.0)	66.7%	0.032∗
Environment certifications	39.4% (0.0)	31.6% (−0.5)	45.0% (0.4)	38.9%	0.689
Social certifications	12.1% (−0.5)	15.8% (0.1)	20.0% (0.5)	15.3%	0.740
Sectoral certifications	51.5% (0.5)	42.1% (−0.2)	40.0% (−0.4)	45.8%	0.667
Direct sustainable accountability					
Environmental impact	30.3% (−1.3)	31.6% (−0.9)	85.0% (2.6)	45.8%	0.000∗∗∗
Social impact	3.0% (−1.4)	0.0% (−1.5)	35.0% (3.2)	11,1%	0.000∗∗∗
No. of companies	33	19	20	72	

Note: Pearson's Chi-square test (for dummy variables) or ANOVA (for ordinal variables) were conducted to analyze differences between the clusters. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$
For dummy variables, each cell includes the percentage of companies in each cluster and the value of the standardized residuals (in parentheses). For scale variables, each cell reports the mean value

company must maintain in its process and product quality system. The shares of users of ISO 9000 are significantly higher among "anticipators" and "optimizers" (85% and 73.7%, respectively) than among "conservatives" (51.5%) ($p < 0.05$).

The use of measures of direct sustainable accountability distinguishes the "anticipators" from "optimizers" and "conservatives." More specifically, 85% of anticipators make regular use of measures for monitoring and evaluating the environmental impact of their activities, while these are adopted by only one-third of "optimizers" and "conservatives" ($p < 0.001$). These measures are usually developed ad hoc by the company, or even "proposed" by quality certifiers, and these measures allow companies to regularly monitor their overall resource consumption, energy consumption, waste management, and emissions of CO_2 and other polluting gases. On the contrary, the use of measures aimed at detecting social

Table 4.4 Stakeholder engagement: means, standard deviations, and variance analysis

Stakeholder engagement	Clusters (b)			Total	*p*-value (a)
	Conservatives	Optimizers	Anticipators		
Number of stakeholders					
No. of stakeholders	17,879	17,895	32,000	21,806	0.003**
Type of stakeholders					
Employees	51.5% (−0.6)	57.9% (−0.1)	75.0% (0.9)	51.5%	0.236
Clients	57.6% (−0.5)	47.4% (−1.0)	95.0% (1.6)	65.3%	0.003**
Suppliers	39.4% (−1.0)	42.1% (−0.6)	80.0% (1.8)	51.4%	0.011*
Society	30.3% (−1.0)	31.6% (−0.7)	70.0% (2.0)	41.7%	0.010*
Engagement mechanism					
Online consultation	27.3% (−1.3)	26.3% (−1.0)	80.0% (2.7)	41.7%	0.000***
Dedicated listening lines	57.6% (−0.4)	47.4% (−0.8)	85.0% (1.3)	62.5%	0.038*
Focus groups/ workshops	27.3% (−0.7)	21.1% (−1.0)	60.0% (1.9)	34.7%	0.018*
No. of companies	33	19	20	72	

Note: Pearson's Chi-square test (for dummy variables) or ANOVA (for ordinal variables) were conducted to analyze differences between the clusters; $*p < 0.05$, $**p < 0.01$, $***p < 0.001$
For dummy variables, each cell includes the percentage of companies in each cluster and the value of the standardized residuals (in parentheses). For scale variables, each cell reports the mean value

impact is generally less widespread but greater among "anticipators" (35%) than "conservatives" and "optimizers" (3% and 0%, respectively, $p < 0.001$).

Statistically significant differences emerge when comparing stakeholder engagement initiatives among the three clusters, suggesting the existence of a relationship with SI strategies. Table 4.4 reveals that the most significant differences concern "anticipators," when compared with "conservatives" and "optimizers."

The number of stakeholder categories engaged by companies is, on average, higher among "anticipators" than "conservatives" and "optimizers." While "anticipators" engage 3.2 stakeholder categories on average, the mean is only about 1.7 for both "conservatives" and "optimizers" ($p < 0.01$). Moreover, while almost all "anticipators" engage clients in their business activities (95.0%), only 57.6% of "conservatives" and 47.4% of "optimizers" do likewise ($p < 0.01$). In addition, 80% of "anticipators" engage and collaborate with suppliers, against 39.4% of "conservatives" and 42.1% of "optimizers," while 70% engage other societal actors (with a lower percentage among both "conservatives" and "optimizers") ($p < 0.10$).

"Anticipators" involve different types of stakeholders in their business activities and use innovative tools to promote collaboration and knowledge exchange with them. For example, 80% of "anticipators" use online consultation mechanisms—mail, (corporate) websites, and portals dedicated to corporate sustainability issues,

internal social networks, and virtual training sessions—to interact with different stakeholders.

By contrast, online consultations are adopted by just one quarter of "conservatives" and "optimizers." Furthermore, 85% of anticipators use dedicated listening lines, against 57.6% among "conservatives" and 47.4% among "optimizers" ($p < 0.05$). These communication channels include individual interviews, group meetings, free-phone lines, courtesy calls, and questionnaires that companies use to interact with customers, employees, and suppliers. Finally, 60% of "anticipators" organize focus groups and workshops, where customers, employees, suppliers, and societal actors can participate jointly or separately. Only 21.1% of "optimizers" and 27.3% of "conservatives" use focus groups and workshops ($p < 0.05$).

4.4 The Role of Stakeholder Engagement for Developing SI Strategies

This study reveals the existence of three different strategic groups of companies in the agro-food sector with respect to SI. These groups have been labelled as "conservative," "optimizer," and "anticipator," thus distinguishing different strategic approaches to SI.

In the first group, companies adopt a "conservative" approach to SI, producing the same things in the same way and limiting them to respecting existing regulation. The second and intermediate group of "optimizers" includes companies that have innovated toward sustainability, mainly to increase the efficiency of their production processes. Finally, the group of greater development for SI is the "anticipators," including those companies that, besides substantially changing their processes, also change, or rather diversify, their core businesses by introducing sustainable products. These strategic groups are similar to those found in previous studies in the literature on corporate and SI strategies (see, e.g., Baumgartner and Ebner 2010; Buysse and Verbeke 2003; Bos-Brouwers 2010; Dunphy 2011; Klewitz and Hansen 2014; Schaltegger et al. 2012).

Each strategic group embeds different strategic choices about the type and level of diffusion of SI activities. The proactive "anticipators" group shows a high degree of SI in terms of the number and variety of SI types implemented. In all the strategic groups, SI concerns mainly the environmental dimension, while process and product innovations with a focus on social impact are almost entirely absent. This result could be partly due to the sector considered in this study: food entrepreneurs appear to have an approach to sustainability that focuses largely on the environmental dimension.

Exploring the differences among the three strategic bundles shows that the degree of SI is substantially independent of companies' economic sector, size, and geographical location. Thus, it can be supposed that company innovativeness and

Table 4.5 Main results of the empirical study

Strategic groups	Types of innovation	Main characteristics of stakeholder engagement	Degree of SI
1. Conservative	None or limited innovation	• Limited number and types of stakeholder groups involved • Limited use of involving and collaborating tools • Limited adoption of CSR practices • Use of certification and standards (with the exception of ISO 9000)	+
2. Optimizer	Process innovation	• Limited number and types of stakeholder groups involved. • Limited use of involving and collaborating tools • CSR system • Use of renewable resources • Management of environmental impact • Indirect sustainable accountability	++
3. Anticipator	Process and product innovations	• Higher number and types of stakeholder groups involved • Adoption of collaboration tools • CSR system • Use of renewable resources • Management of environmental impact • Indirect and direct accountability	+++

sustainability orientation are not mediated by structural factors, but internal business practices related to stakeholder engagement play a critical role.

Table 4.5 summarizes the key results related to the main characteristics differentiating each strategic group, as described in the previous section.

Although these results are not unique, they suggest that the cultural attributes of stakeholder engagement, synthesized by using a set of CSR practices, can drive the development of SI strategies. Indeed, companies which innovate toward sustainability—both "optimizers" and "anticipators"—make greater use of CSR tools, indirect sustainability accountability, and quality standards when compared to "conservatives." However, the adoption of a complete CSR system does not emerge as potential driver for SI. This may be explained by the fact that most companies in the sample were small, and so might prefer to adopt specific CSR practices rather than develop an integrated strategic CSR system. Another notable result is that only the "anticipators" implement direct sustainable accountability. In this case, direct sustainability accountability could be considered a consequence, rather than a driver, of companies' sustainability orientation. Indeed, more proactive companies could also be more incentivized and have greater need to assess the environmental and social impact of their activities.

The results suggest that culture issues can play an important role for innovators in fostering the integration of sustainability issues into innovation strategies. However, culture is not enough for the development of successful SI strategies.

Indeed, this empirical study shows that what differentiates *anticipator strategies* is the company's capability to involve and collaborate with a greater number of primary and secondary stakeholders. "Anticipators" are companies that involve different primary and secondary stakeholders in their business activities and also make greater use of engagement tools—such as online consultation, dedicated lines, and workshops—to support dialog, collaboration, and sharing of different ideas, knowledge, and expertise with various stakeholders. In other words, "anticipators" are companies that engage a wider range of stakeholders through mechanisms of listening and dialog that open channels of collaboration in order to capture various ideas and interdisciplinary knowledge and competencies, and convert them into innovative products, services, and processes. Growing numbers of companies are discovering that the locus of knowledge generation, SI, and ultimately value creation is located outside their boundaries, for which reason they need to open their innovation processes and collaborate with other actors (Altenburger 2018). Stakeholder engagement thus concerns the firm's capability to seek engagement and collaboration with the quadruple helix of stakeholders that can enhance mutual learning and mobilization of knowledge and drive the success and effectiveness of SI strategies.

4.5 Conclusions

In conclusion, this study contributes to the emerging knowledge of SI strategies by providing new evidence from the agro-food sector in a specific national context. In line with the literature on open and collaborative innovation, this study provides new evidence on the role of stakeholder engagement for the development of successful SI strategies. More specifically, it shows that the management of a wider range of stakeholder relationships, through mechanisms of collaboration and involvement, characterizes the most innovative companies that follow an "anticipator" strategy in making their business models sustainable.

If companies aspire to play a leading role in SI, they must connect collaborative stakeholder engagement to strategic SI. They have to open their innovation processes to engagement with various stakeholders to mobilize knowledge that helps the company grasp sustainability needs and create sustainable solutions.

Future research opportunities include strengthening the theoretical framework and empirical evidence on the collaborative approach to stakeholder engagement in the SI field and understanding how firms' capabilities, strategies, and organizational cultures support the management of collaborative relationships for developing SI strategies and transforming different sources of knowledge and ideas into sustainable solutions. In this regard, CASIPEDIA may represent a valuable database for scholars to explore the relationship between SI and stakeholder engagement. Indeed, for each good practice of SI mapped in CASIPEDIA, detailed information is available on (1) the type of stakeholder involved, (2) the phase in which each stakeholder has been involved, (3) the contribution of each type of stakeholder (in each phase), and

(4) the mechanisms (tools) used by innovators to collaborate with stakeholders. Acknowledging the importance of stakeholder involvement for SI, future research could exploit CASIPEDIA to study how stakeholders can be involved, which stakeholders are generally involved, what they contribute, and which are the most effective models to manage stakeholder engagement within sustainable projects.

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Chapter 5
Targeted Forward-Looking Citizen Engagement: The Case of Sustainable Innovation

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Abstract Making the future more sustainable is arguably a challenging task if not a 'wicked' problem. Not only does sustainability incorporate social, environmental, economic and cultural elements, but there is also the question about on whose terms and in whose interests sustainability should be targeted. To meet these aims, we reviewed how European citizens envision desirable and sustainable futures. As data we used citizen visions from three involvement exercises in which citizens drafted a total of 298 visions. We used the methodology of topic modelling to identify how people's agendas for sustainable futures are expressed in the visions examined. Twenty such agendas were identified and we further examined how these agendas relate to sustainable innovation, which is one of the key ways to achieve better sustainability. Three agendas are highlighted in the context of sustainable innovation and relate to use of natural resources: 'System resources', 'New food markets' and 'Farming innovations'. 'Developmental education' is a lesser agenda in comparison to all-encompassing contexts. Similarly, agendas concerning 'Collectives', 'People's channel' and 'Science' are more closely related to general sustainability targets than sustainable innovation. The final section of the chapter presents discussion of these results and the application of methods developed for natural language processing in identifying citizen agenda.

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5.1 Introduction

What is it that people want in a sustainable future? This seemingly simple question opens myriad issues. In particular, the critique of unsustainable consumption patterns and systems has been of recurrent interest. Assadourian (2010) argues that dominant interests in business, the media, governments and education contribute to detrimental consumerism. Kemper and Ballantine (2017) tackle obesity, climate change and poverty from a transition perspective, highlighting that social aspects need to be addressed when changing undesirable and collective behaviour. Kennedy (2017), in turn, calls for a defragmentation of macrosocial marketing to better address holistic systemic change. In a recent article, Little et al. (2019) proposed macrosocial interventions to address the shortcomings of unsustainable production and consumption systems. Indeed, questions such as these can deservedly be called important and 'wicked' in the sense that there are no obvious or even workable solutions to them (Wooliscroft 2016; Rittel et al. 1973).

At the same time, individuals and their collectives can be seen as a source of change for the better. Kozinets et al. (2008) argues that consumers can produce collective innovation both as an outcome of their consumption and as an active member of consumer communities. Chaudhury and Albinsson (2015) applied the construct of citizen–consumers to show how people contribute to change in the food system. Hogg (2018) investigated conceptually the power and role of consumers to shape the macro environment and found them to be small, and asks what the focal role of consumers could be in changing ecosystems. The governance of sustainable innovation could indeed benefit from citizen participation.

Accounting for these research approaches, we explore how people in their roles of citizens and consumers could contribute to ensure a more sustainable future through agenda setting in research and innovation. This chapter reviews the starting point of such exploration, namely the question of what people would prefer sustainable futures to be like. As data, we used a large number of visions on sustainable futures, which were authored by citizens in three major European research projects that aimed to influence Horizon 2020, the European research and innovation programme. In particular, we examine how citizen visions that connect closely to sustainable innovation differ from those, which are all-encompassing in character.

In line with these aims, the upcoming section describes the policy background of the chapter as it connects citizen engagement and sustainable innovation, i.e. 'any incremental or radical change in the social, service, product, governance, organisational, system and marketing landscape that leads to positive environmental, economic and social transformations without compromising the needs, welfare and wellbeing of current and future generations' (Popper et al. 2016) to the European Union's efforts to invite the public to influence the agendas of research and innovation. This is followed by topic modelling of the citizen visions authored in the three citizen engagement projects examined, which reveal differences in topical distribution of citizen visions across the three projects: CIVISTI (Citizen Visions on Science, Technology and Innovation 2011), CASI (Public Participation in

Developing a Common Framework for the Assessment and Management of Sustainable Innovation 2014) and CIMULACT (Citizen and Multi-Actor Consultation on Horizon 2020, 2016). The citizen visions articulated in the CASI project have been used as a focal point because they target sustainable innovation. Indeed, when sustainable innovation is seen as a specified mean to approach the future, the importance of system resources such as energy and production is accentuated, and education is seen as a more moderate driver for change. New food markets and farming innovations, in turn, emerge in citizen visions which consider sustainable innovation. The final section of this chapter discusses these findings and accrued methodological learning.

5.2 Open Agenda Setting for Research and Innovation Programmes

In recent years, citizens across Europe have systematically been invited to participate in agenda setting for European research and innovation. To this aim, the European Commission has funded research projects in which citizens have articulated visions on a sustainable future, thereby forming citizen-induced interests for the European Union's Horizon 2020 programme. Policy inclusiveness through citizen engagement has the potential to introduce innovation agendas in addition to informing the public about scientific and technological advances (see Rip 2016). A total of 298 such visions were authored by citizens in three major European-scale projects: CIVISTI (2011), CASI (2014) and CIMULACT (2016). These visions were followed by 'backcasting' procedures (Quist et al. 2011; Robinson et al. 2011; Vergragt and Quist 2011), which built pathways and roadmaps for European research and innovation to match the visions desired by the citizens. Such a procedure builds path-dependency (see Layton and Duffy 2018) towards desired futures, which further highlights the role of open and inclusive agenda setting. Indeed, lobbying for public support is gaining increasing attention in the governance of sustainability transition (Köhler et al. 2019). Further, governance of sustainable innovation can support accelerated diffusion of new solutions as it brings together policy with innovation activities (Matschoss and Repo 2018).

But what if citizen engagement through open agenda setting implicitly presupposes that the roadmap to the future should be reached in a particular way? Could this affect the visions that the citizens articulate, and if so, which topics would be accentuated? This chapter examines these interesting questions by analysing the visions co-authored by citizens in the three projects. The CASI project serves as the focal point of analysis as it had a specific focus and approach—that of sustainable innovation—and citizen engagement was not the only key activity accomplished in the project. CIVISTI and CIMULACT, to the contrary, were all-encompassing in terms of focus and were built on the outcomes of citizen engagement. The citizen engagement methodology itself was uniform across these projects, which makes the visions readily comparable, and differences in the visions collected across the

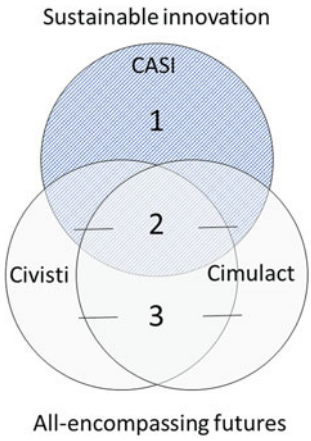

Fig. 5.1 Research design of the chapter with three types of comparative data

engagement exercises have been observed in earlier research (Repo and Matschoss 2018).

The research design of this chapter is presented in Fig. 5.1. Citizen visions and the latent agendas of the CASI project serve as the focal point against which contributions from the CIVISTI and CIMULACT projects are compared. Such comparison is apt to show how citizen perspectives on futures that highlight sustainable innovation (CASI) differ from all-encompassing citizen perspectives on the future. Three kinds of comparative data were sought for: 1) citizen agendas which are specific to sustainable innovation, 2) citizen agendas which are shared between sustainable innovation and all-encompassing perspectives but possibly to varying degrees, and 3) citizen agendas which are evident in all-encompassing perspectives but missing or limited for sustainable innovation. These three sets of data are numbered accordingly in Fig. 5.1.

The profound focus of the CASI project on sustainable innovation was reflected in all of its activities, including the activities that involved citizens in research agenda setting. For this reason, the citizen visions articulated in the CASI project were differently targeted than the citizen visions from the all-encompassing CIVISTI and CIMULACT projects. Previous work has demonstrated this to be the case (Repo and Matschoss 2018), and the chapter at hand looks in greater detail at the differences. The upcoming sections further elaborate on the relevance of engaging citizens in open agenda setting, while arguing for the use of the citizen visions authored in the CASI project, with sustainable innovation as a focal point for comparison against all-encompassing citizen visions.

5.2.1 Engaging Citizens in Open Agenda Setting

In recent years, activities engaging citizens in the open research agenda setting have been carried out in many parts of the world (OECD 2017). In Europe, the EU funded CIVISTI, CASI and CIMULACT projects demonstrated how such engagement can

feed into the formulation of detailed research topics and give direction to research programmes. These experiments mark an emerging shift towards an earlier involvement of citizens in research and innovation, particularly at the level of framing agendas and objectives to be funded by the European Commission in its research programme. Earlier citizen science initiatives have engaged citizens in collecting research data and helped improve innovation close to markets. However, researchers, politicians and stakeholder organisations alike have argued for more open and earlier engagement. Agenda setting is important in this respect as it brings issues to the attention of the public and elites (Birkland 2006; Howlett et al. 2009).

There are complementary arguments for citizen engagement, which range from functionality and neo-liberalism to deliberative, anthropological, emancipatory and post-modern concepts (Renn and Schweizer 2009). The main, principled argument for more citizen engagement is both functional and deliberative in nature: since research and innovation shape the future of our society and when it is publicly funded, it is arguable that citizens should have a say over the way research funding is spent. A common objection to this argument is that only professionals and experts know how to do research and that citizens are therefore unqualified to make decisions about research objectives. Yet citizen engagement does not mean handing over complex decision-making to citizens alone but rather it provides them with an opportunity to be heard in decision-making. This may have practical relevance as it has been noted that citizen-influenced agendas differ from those set through conventional processes (Rosa et al. 2018; Repo and Matschoss 2019), and thereby contribute to innovations, which could be better accepted by the public.

5.2.2 Targeting Sustainable Innovation in CASI

The CASI project set out on a challenge to explore sustainable innovation and to define a management and assessment framework that was to be informed through various forms of public engagement, specifically to target sustainable innovation. The project was initiated because it was considered in the European Commission that there was conceptual ambiguity around the concept of sustainable innovation that spanned both academic and practitioner communities. Indeed, on the one hand, the concept relates to concepts such as eco-innovation or green innovation, while on the other, it can also be understood to touch sustainability and sustainable development. Therefore, the CASI project was designed with the intention of bringing together several kinds of societal actors, including citizens, to understand better what sustainable innovation means from their various perspectives. In fact, societal actors have a range of expectations even towards the concept of sustainability itself, a core concept behind sustainable innovation. The project thus set a goal to map ongoing sustainable innovations and to develop a coherent understanding of sustainable innovation as a concept.

CASI ran concurrently with ongoing debates as to what sustainable innovation entails, and within a context, where there was little agreement on either its scope or emergent validity. Therefore, it was an important ambition of the project to attempt

to establish sustainable innovation as a valid construct informed by both praxis and innovation theory. Combining multiple knowledge streams, CASI explored sustainable innovation as a concept, as well as through hundreds of cases of sustainable innovation, to validate the importance of innovation within the context of sustainability. It applied and developed the CASI-F Framework (Popper et al. 2017) with tools and processes to enable multiple societal actors to convene into a common process of co-creating and sharing knowledge, and informing policy agenda setting.

In the case of sustainable innovation, the arguments for citizen engagement in an open research agenda setting are based on the complexity of societal change towards sustainability: indeed, the transition to a more sustainable society is a challenge of immense complexity, a wicked problem (e.g. Wooliscroft 2016), that requires the engagement of all walks of society. The research priorities identified by citizens in the CASI project differed from the priorities set by the experts (Repo and Matschoss 2019) and stakeholders engaged and from those set by the Commission (SC5 priorities in Horizon 2020). Indeed, when it came to identifying the kind of research needed to achieve identified priorities, citizens prioritised different research activities than the experts and stakeholders did (Bedsted et al. 2016; Repo and Matschoss 2019). In general, the latter tended to be more instrumental, technically oriented, narrower in scope and less societal. Another important observation and argument for citizen engagement in research agenda setting for sustainable innovation is the fact that citizens favour research agendas that will enable them to take an active part in the transition to a more sustainable society. This is an important difference from research agendas framed by experts that emphasised less the social aspects of research agendas, exemplified by a research agenda suggestion called ‘More green in cities’, which was ranked second-last in the list of experts but among the ten most-preferred in the list of the citizens (Repo and Matschoss 2019).

The upcoming sections describe how we observe differences between envisioned futures. The results reveal the topics that citizens wish to address with sustainable innovation.

5.3 Data and Methods: Topic Modelling of Citizen Visions

Topic modelling as applied in this study allows an examination of the future from a systemic perspective, i.e. as a societal marketing system, in which networks of people participate in economic exchange that responds to customer demand (see Layton 2007, 2019 for a working definition of marketing systems). In the case of citizen visions, accordingly, statistical co-occurrences of words contribute to ‘topics’, which are used to examine the full corpus consisting of 298 visions. The benefit of the application of topic modelling is that it provides a means to a systematic analysis of unstructured texts which contain numerous and sometimes ‘latent’ topics which could go missing or be difficult to identify in qualitative analysis. Furthermore, topic modelling contributes to a clearer distinction between the technical and interpretive stages of text analysis (Repo et al. 2017).

The methodological approach of topic modelling echoes with Ekici and Ekici (2016), who advocate to consider Bayesian statistics in the domain of ethics. Accordingly, Wooliscroft (2016) welcomes Bayesian analysis, which has been spurred by developments in both computing power and software development. As Ekici and Ekici (2016) demonstrate, novel methodologies provide new tools for analysis and can reveal issues and connections which were not as observable before.

To examine if targeted engagement activities can produce topically different sets of visions, we review the results of three citizen engagement projects: CIVISTI (2011), CASI (2014) and CIMULACT (2016). These projects all applied a citizen engagement procedure first developed in the CIVISTI project that aimed to deliver citizen-driven research ideas into the design of research programmes. The first step in this procedure is to create visions on sustainable futures with groups of citizens in different countries. Participating citizens were selected according to similar principles in all three projects: participants with no specialised knowledge on the themes of the workshop and with as varied a background as possible. National representation in terms of population structure was not strived for. This chapter utilises the citizen visions created in these projects as the empirical research material (Rask and Damianova 2009; Kaarakainen et al. 2015; Riisgaard et al. 2017). Example 1 introduces one citizen vision from the CASI project, which focused on sustainable innovation.

Example 1: Urban Farming
Urban farming means farming on the roofs, balconies and gardens of urban cities. This would bring all spaces of cities into beneficial use. For houses with flat roofs, solar panels could be used as roofs and the greenhouses would be situated underneath them. Urban farming would bring more vibrancy and nature into urban environments. In addition, urban farming would create carbon sinks, which are needed in urban environments; it would contribute to local food production, and commit people to communal local activity, which transcends generations. *(Excerpt from citizen vision on urban farming, which was authored in the citizen panel in Finland in the CASI project. (See Appendix 6.1 for full vision)).*

The procedure and the results of these projects have been examined and published previously in respective projects in Gudowsky et al. (2016), Repo et al. (2017) and Rosa et al. (2018). The study by Repo and Matschoss (2018) is so far the only analysis which combines and compares data from all three projects and argues that project settings indeed affected the agendas evident in the citizen visions. As there are publications that go into detail in terms of procedure and results, here we have provided a brief review of the main targets and some basic details of these projects. The target of the CASI project was to examine sustainable innovation, and the role of citizen engagement was to support a creation of a general methodology for the assessment of sustainable innovation. Accordingly, the CASI project involved citizens in 12 countries and contributed to 50 visions in 2015. The CIVISTI and CIMULACT projects were of an all-encompassing character in terms of outreach,

and with this aim in mind, CIVISTI involved citizens in seven countries, contributing to 69 visions in 2009, and CIMULACT in 30 countries, contributing to 179 visions in 2015–2016.

The 298 citizen created visions on sustainable futures form the corpus of our analysis. The corpus was analysed with a topic modelling methodology (Blei 2012; Blei et al. 2003) by using the Mallet toolkit, which is a machine-learning language-processing tool for natural language texts (McCallum 2002).[1] In the analysis, we applied Latent Dirichlet Allocation (LDA) to discover topics in the visions corpus with model optimisation after every ten sampling iterations. In the next section, we present the results of the topic modelling.

5.4 Results: Topics from the Engagement Projects

For the analysis of the citizen visions, we applied 20 topics to analyse arguments emerging in the visions in the three engagement projects. This substantial number of topics was selected to examine in detail how the visions articulated by citizens in the CASI project, which targeted sustainable innovation, corresponded with those articulated on the more generally oriented CIVISTI and CIMULACT projects. In previous work, Repo and Matschoss (2018) showed that there were topical differences between the citizen visions in the three projects, and our work at hand attempts to review this observation in greater detail. The 20 topics are also good in relation to the procedures and numbers of interpretive units, which were applied in the analysis of the visions in the three projects (CASI: eight topic clusters, CIVISTI: 37 topics, CIMULACT: 12 domains with 29 underlying needs).

The analysis contributes a Dirichlet parameter for each topic, which represents the relative weight of that topic in the full corpus, and keywords for each topic as well as other diagnostic information. We used these keywords and, in particular, their exclusivity to their respective topic as the grounds for labelling the topics. Table 5.1 presents the topics, their Dirichlet parameter and the top 20 keywords.

The results of the modelling show that two topics are of greater magnitude than the others in the citizen visions: ‘System resources’ and ‘Developmental education’ with Dirichlet parameters of 49.09 and 41.73. The emergence of the topic of ‘System resources’ appears logical as citizens were instructed to draw visions which were desirable and achievable. Hence, considering the available resources in a systemic context is a functional foundation on which to connect visions. The topic of ‘Developmental education’, in contrast, relates to approaching and welcoming desirable futures. The topic of ‘Costs and benefits’ also receives more attention than the remaining 17 topics with a Dirichlet parameter of 9.82 and relates to the argumentation for better futures.

[1] http://mallet.cs.umass.edu/

Table 5.1 Twenty topics in the citizen visions data with relative weight and keywords

Topic	Dirichlet parameter	Keywords
System resources	49.09	Energy, system, resources, development, citizens, production, food, education, quality, local, sustainable, individual, city, environment, public, knowledge, change, society, common, social, products, transport, green, healthy, vision, access, economic, environmental, people, responsible, political, care, renewable, power, sources, activities, good, learning, support, long, economy, small, human, water, awareness, areas, developed, level, companies, schools
Developmental education	41.73	People, life, work, education, vision, society, health, family, time, children, social, community, technology, future, school, living, world, based, information, working, free, natural, live, personal, responsibility, waste, home, nature, water, part, cultural, important, human, day, place, space, ecological, Europe, state, basic, means, age, communication, values, making, decision, solar, technologies, person, equal
Costs and benefits	9.82	Benefits, negative, population, high, needed, cost, services, decrease, devices, agriculture, legislation, room, animal, product, innovation, type, policies, saving, hand, effects, policy, distributed, action, animals, level, functions, single, case, problems, infrastructure, capital, control, attitudes, institutions, risk, clear, conflict, supporting, beauty, experts, providing, welfare, traditional, bike, light, united, adoption, exercise, collaboration, creating
Production	2.32	Cells, senior, popular, thing, professionals, engage, gardening, compulsory, manufacturing, orientation, lands, ethically, root, listen, powered, agreed, theatre, cycles, subsidies, built, located, shaping, rewards, popularization, unbiased, functioning, hear, insurance, sustaining, works, foundations, specialization, majority, conversation, intelligent, limits, universities, maturity, privacy, roles, act, makers, obtained, possibilities, nutritious, reduce, R&D, high, intangible, deficiencies
Treatments	2.10	Called, financed, treatments, remains, travelling, practical, implemented, debate, continuing, criminal, visual, heating, elementary, recommend, held, materialism, reporting, separate, feel, purpose, hands, representatives, include, realizing, salad, fathers, balancing, payment, bankers, numerous, enhancement, sized, Sweden, arriving, reserved, total, organs, methane, obligation, military, determination, doctors, digital, specialist, parent, presents, experiences, wave, revaluation, reward
People's channel	1.79	Language, families, dying, electric, transportation, research, countries, languages, channel, weapons, means, programs, employment, stay, disability, mother, Bulgaria, full, aging, easily, year, abroad, inclusion, council, fields, identity, kindergarten, doesn't, times, starts, continue, fusion, realized, planning, Africa, individual, form, dependents, legacy, afb,

(continued)

Table 5.1 (continued)

Topic	Dirichlet parameter	Keywords
		perform, translation, father, union, funds, learn, contents, Hungarian, Sofia, television
Improvements	1.62	Analysis, secured, vehicle, shift, blind, workshops, enabled, components, renovation, retailing, motivate, supports, efforts, cares, fission, cafe, intelligence, kitchen, welcoming, hearing, wanted, priorities, heart, pick, neighbors, consumable, norm, urbanisation, die, debates, evaluation, depend, offers, extended, polluted, illnesses, stay, wouldn't, sensors, opinion, valued, abolishment, assistance, preserved, considerable, tradition, smes, dissemination, return, antibiotics
Infrastructures	1.61	Plant, productivity, disposal, functioning, neutral, present, bigger, relax, cease, circumstances, passenger, travels, preventive, sustaining, break, lessons, gas, activity, earth, accordance, find, utopia, valuable, money, manner, investments, comprehensive, tendencies, transporting, parental, dependencies, rule, inability, table, owned, cheap, greenery, opening, left, background, humane, signed, households, plot, features, fairly, mentioned, ideal, intellectual, toll
Accomplishment	1.40	Dimensions, realized, forced, low, begins, employers, controls, children's, introduce, controlled, rely, losing, treatment, learning, foundation, corporate, compulsory, greater, representatives, involvement, characterised, typical, tank, inequality, autonomous, compost, shops, diets, economics, peculiarities, forms, platform, threatened, equipment, real, multiculturalism, provided, bio, developed, increase, outlets, dry, curriculums, substitute, prenatal, maximize, cohabitation, warm, intelligences, daughter
New food markets	1.34	Farming, urban, insects, cannabis, supports, barriers, reducing, distributive, immigrants, sales, consumers, buy, gardener, surrounding, markets, inhabitants, improved, construction, oriented, large, technological, ecosystems, villages, assumption, provide, circular, objectives, focus, enables, sale, roofs, consuming, harvest, importance, allocation, pharmaceutical, realisation, principles, realise, enhancing, focused, stimulated, decreases, locations, seeds, customers, clean, attractive, corridors, physically
Common cures	1.23	Thinking, cure, cooperative, maintain, abuse, demands, determine, zone, unconditional, cleaner, governance, giving, resolved, equipped, code, possibly, teleportation, autonomous, specialized, consists, simple, businesses, lines, tunnel, forward, learns, physics, breakthrough, educate, ago, learned, solely, cellular, choosing, walk, opens, generational, interesting, transports, todays, determination, interested, decide, ethnic, strategies, expensive, applicable, intensive, action, producers
Farming innovations	1.18	Element, limiting, inspired, cooperatives, experiments, nearby, fostering, soil, farm, accessibility, center, fallow, multiple, grid, clubs, purchases, alike, planning, utilised,

(continued)

Table 5.1 (continued)

Topic	Dirichlet parameter	Keywords
		harmful, generating, carrying, open, international, municipalities, sinks, situated, weather, pieces, fuelled, enabling, ante, garden, simultaneously, pipes, crumbling, practise, profitable, fanaticism, scoring, optimization, self-sufficiency, opposition, deficits, point, potentially, boards, device, reuse, farmers
Communities	1.15	Neighbourhood, expectancy, consume, minimum, diagnosis, flexible, proper, oil, pace, homo, homes, pensions, kids, kindergarten, organizing, effectiveness, style, district, importance, sustainably, automatic, connections, plots, generation, range, society, recovered, autonomy, attend, calling, stylish, arranged, pierino, hub, fatal, half, solve, mixed, proximity, officer, immaterial, speaking, ensured, ranging, views, individuality, alienation, rail, train, agora
Technodreams	1.14	Hydrogen, personality, agency, sound, train, provision, called, fundamental, villages, turbines, manufacturers, innovative, marginalization, beaming, China, outer, neighbour, report, woman, renewal, circumstances, test, frame, cells, pension, enrolment, owners, areas, worlds, program, paper, emergency, enables, conflicts, conventional, understandable, linguistic, desc, grieving, climax, phase, stranded, rubbish, party, scientifically, realising, newer, cherish, retiring, tranquil
Solutions	1.13	Works, taught, commitment, windows, transferred, direction, solution, unequal, consumers, malo, middlemen, recognized, hear, inheritance, socialization, nano, imagine, cloning, canteen, standardized, belongs, internet, salary, brain, reduced, skilled, explored, chess, vis, requiring, preventative, performances, flower, ice, limitation, unhealthy, discussed, segregation, racists, remote, freight, hives, transmissions, underlying, annual, battery, drive, translation, backgrounds, hackers
Science	0.79	His/her, s/he, Finland, scientific, peoples, countries, death, general, studies, wide, matters, station, humankind, tells, controlled, scientists, user, makers, aim, plain, stored, matter, partner, shown, unit, workshop, renewed, special, staff, advanced, year, inventions, phase, wrist, ageing, Europe, entitlement, selective, aids, nation, operations, bicycle, buses, behavior, effort, enrich, child, visit, face, makes
Collectives	0.68	Desirable, today, collective, income, care, agnes, concerns, participatory, professions, critical, consideration, nowadays, shorter, discrimination, fundamental, grown, concern, cradle, learning, feel, solidarity, alice, helping, seniors, spend, evolution, robots, terms, source, democracy, result, waiting, adapt, mix, patients, voting, choose, reality, emotional, context, driving, play, green, cities, food, remote, pillars, experiential, robotics, comfortable
Business restraints	0.51	Contacts, commercial, economical, technical, farmer, potential, passport, rush, alive, involving, talent, slurry, selection,

(continued)

Table 5.1 (continued)

Topic	Dirichlet parameter	Keywords
		resulting, healthier, solving, survivors, uniformity, she, told, decades, parliamentarians, retired, laboratories, globalisation, Tuesday, specially, ecosystem, mums, prepare, intelligence, it's, period, backward, faced, left, protects, Denmark, panel, bed, controlled, computer, doctors, contact, personalities, cars, realized, organized, forms, learning
Arts	0.30	Pupils, artisan, wages, preventive, reflection, creativity, freedom, individuals, live, localised, documented, unacceptable, box, combination, passions, habit, addressed, joining, owned, falling, external, indicator, gave, dimensional, meetings, vice, insurance, frontier, happily, practiced, minimised, propose, incurable, loneliness, diffuse, pre, kids, happier, extent, equivalent, transmission, parent, tailored, dependency, standard, nutrition, compromises, Nigeria, oceans, louise
Intergenerational concerns	0.20	Opportunities, student, intergenerational, absence, train, days, women, sales, childcare, alternatives, amount, speech, transports, lose, devices, resilience, junk, centred, ultra, citizenship, consensus, activity, tradition, moral, democracy, actors, finance, approach, equitable, toxins, emphasizing, accountable, conscientious, passion, forward, saved, saves, remake, wash, robot, sitting, restored, respectable, thirty, indifference, external, counter, taxi, learned, journeys

The topic data are visualised in Fig. 5.2 to review how the 20 topics that were identified relate to each other. To accomplish this, we examined the connections between 50 keywords in each of the 20 topics by use of the Gephi visualisation and exploration software.[2] The data in Fig. 5.2 were visualised using the modularity algorithm to identify clusters, which differ from random distribution (Blondel et al. 2008) and the Yifan Hu layout that reduces complexity through a combination of force-direction with a graph coarsening technique (Hu 2005). The sizes of the keywords reflect their frequencies in the corpus. The basic logic of the visualisation follows that of Underwood (2012), except that all topics were included due to the smaller dataset.

As expected, there are connections between the topics as words in citizen visions are not completely exclusive to topics. Nevertheless, these connections are few in number due to the methodology of topic modelling, which attempts to find latent patterns in the corpus. Among the aims of this chapter, it can be observed that the two main topics in the citizen visions, 'System resources' and 'Developmental education' are more closely connected than any two other topics. 'New food markets' and 'Farming innovations' constitute two separate topics although they

[2] https://gephi.org/

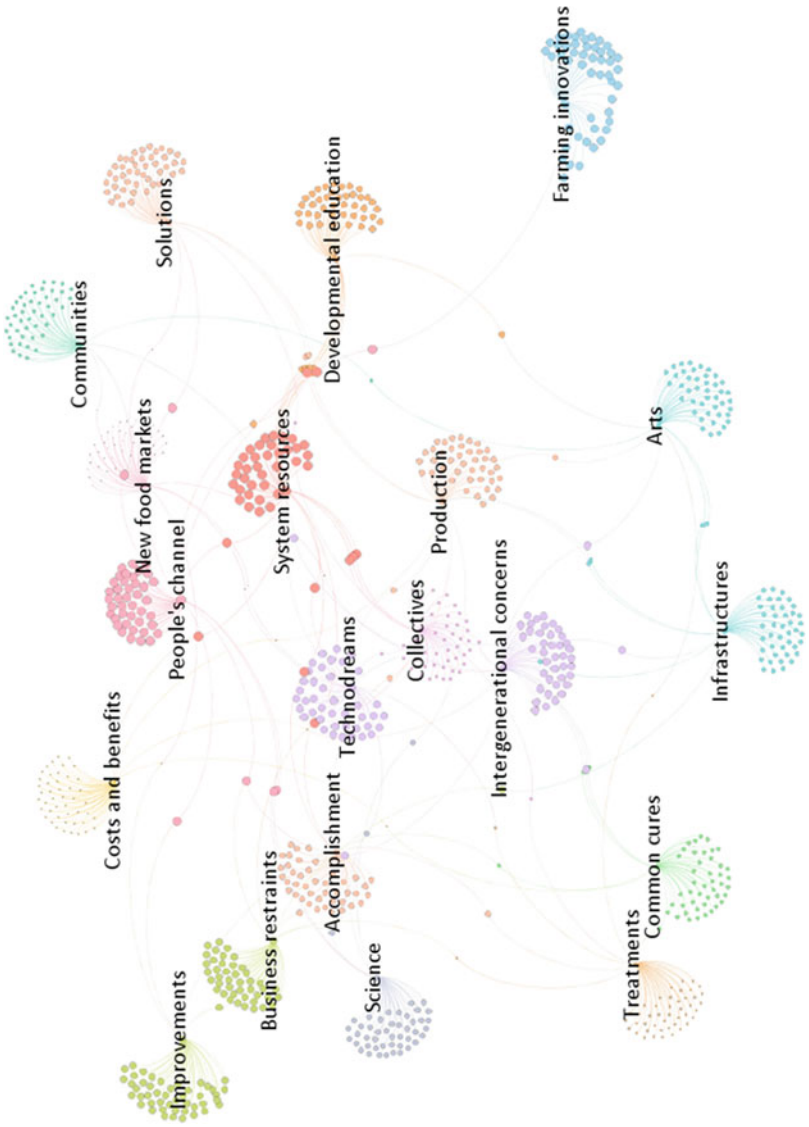

Fig. 5.2 Visualisation of topics in citizen visions

can conceptually be linked to each other through food. It can also be observed that the topics of 'Collectives' are separate from 'Communities' as well as 'People's Channel'. 'Science' for its part connects to a number of other topics such as 'Technodreams', 'Production' and 'People's Channel'.

Although there are connections between the topics, the visualisation confirms that the topics have independent characters. This is the rationale for applying topic modelling, i.e. to discover latent topics in a corpus. It can be assessed that topic modelling performed well in this analysis, and that the data visualisation further validates the implicit assumption that topics indeed form meaningful units of analysis which are sufficiently separate from other respective units. In the next section, we discuss the topical distribution of topics across projects and its implications for sustainable innovation.

5.5 Discussion: Topical Distribution of Topics Across Projects

As the aim of this chapter is to examine how topics, evident in the citizen visions, viewing the future from the perspective of sustainable innovation, i.e. the CASI project, compare to those from all-encompassing citizen involvement projects (CIMULACT and CIVISTI projects), we focused on the topics which exhibit the greatest distributional differences across projects. These include the two largest topics ('System resources' and 'Developmental education') and 'New food markets', 'Farming innovations', 'Collectives', 'People's channel', and 'Infrastructures'. Table 5.2 shows how these topics are distributed across the citizen visions developed in the three involvement projects. The full table of how topics are distributed in the citizen visions in the three involvement projects is presented in Appendix 1.

Table 5.2 shows that citizen involvement in the CASI project which focused on sustainable innovation indeed contributed to a different topical balance from the two more encompassing projects. Firstly, the focus was more on system resources (48.3% for CASI vs. 31.4 and 21.8% for the two others). This is well in line with sustainable innovation relating to the material world and the efficient use of resources. Secondly, 'Developmental education' was less accentuated in the CASI project, which can be explained by reflecting that while sustainable innovation requires knowledge and skills, it is not seen as much as an approach to comprehending the future and changing people. Instead, sustainable innovation is more about implementing knowledge than enlightenment of the public. A contingency table analysis further indicated that the differences were statistically observable at the $p < 0.01$ level concerning the two topics and the three involvement projects.

One key benefit of topic modelling is that it can be used to identify topics that are embedded in a number of visions across all three projects. At the same time, each

Table 5.2 Topical distributions of citizen visions across projects. Key differences from the perspective of CASI-specific involvement is marked in superscript (+/−)

	System resources	Developmental education	New food markets	Farming innovations	Collectives	People's channel	Science
CASI	48.3% $^{+}$	19.1%$^{-}$	13.3%$^{+}$	4.8%$^{+}$	0.0%$^{-}$	0.1%$^{-}$	0.0%$^{-}$
CIMULACT	31.4%	41.0%	0.3%	0.1%	7.5%	0.4%	0.0%
CIVISTI	21.8%	33.2%	0.0%	0.1%	0.0%	13.2%	7.9%

vision may also include several topics. Reviewing visions from this perspective enables us to better understand how citizen visions could shape research and policy agendas. For instance, the CASI vision 'Development of new technologies and improvements of the existing in harmony with nature and society' in the topic of 'System resources' targets a society, which relies on sustainable production and lower environmental burden of goods, better handling of climate change and increased energy efficiency. The benefits of such a vision are both social and environmental. In such a society, the awareness of the requirements for new technologies and products and about sensible consumerism is high. From the environmental point of view, reduced effects of environmental pollution and climate change, more efficient use of energy and natural resources, as well as better recycling of waste, would raise the quality of people's lives. Another example is a vision called 'Sustainable electronics', which is based on an idea that all electronics would be sustainable. Producers would then be responsible for developing their working force and working conditions, as well as for sufficient protection when working with chemicals. In addition, the products would be reusable, repairable and their materials recyclable, with a return system available for both consumers and producers. The advantage of this vision is that the strain on ecosystems would be reduced while a new market is created.

One other topical focus is also striking in the citizen visions in CASI. 'New food markets' and 'Farming innovations' both relate to novel ways of producing and consuming food and are highlighted as topics in CASI while being almost non-existent in the two other involvement projects. This result brings an additional perspective on sustainable innovation as it highlights the fields in which such innovation should be emphasised. An example of a vision in this setting is 'Self-supply with healthy food'. In this vision, technological solutions related to biopesticides and fertilisers have increased yields per hectare, and high standards for eco-production have been introduced in food markets. Indigenous crops have large market shares and a large proportion of the offering is based on seasonal production. In the 'Food for all' vision, the aim is to have nutritious, culturally appropriate and acceptable food to support active and healthy life. This would be achieved, for example by reducing waste throughout the supply chain (storage, transport, supermarket) and by granting access to knowledge on how to grow, cook, store and eat food in new ways. Environmentally sensitive production and local food production is encouraged. Another vision relating to the topic of 'Farming innovations' is 'Insects—the dish of the future', which targets the replacement of costly and often inadequate diets with nutritious insects. A benefit of breeding and producing insect-based food is the creation of new job opportunities, while reducing imports of food. An additional example is the vision on 'Urban farming', which describes farming on the roofs, balconies and gardens of urban cities to bring all available spaces into productive use. Solar panels could be used as roofs for greenhouses, which would be situated beneath them. Urban farming would not only add carbon sinks to urban environments, but also contribute to local food production, and commit people to communal local activity.

It may further be noted that some topics did not emerge in the citizen visions in CASI. The future was seen from the perspective of people as 'Collectives' in the CIMULACT visions and 'People's channel' in the CIVISTI visions. In this respect, focus on sustainable innovation seems to take the focus away from people. 'Science' constituted a particular topic in the project, suggesting a significant demarcation from innovation. Finally, there was only one major topic in CASI, 'Costs and benefits', which was shared with only one of the two all-encompassing projects (see Appendix 2). As this topic relates more to assessment rather than field or issue, it further confirms that topics emerging in the context of sustainable innovation indeed differ from those from all-encompassing contexts.

5.6 Conclusions

Making our future more sustainable is arguably one of the most important and perhaps also 'wicked' challenges of today. Scholars have addressed this challenge by examining the limited sustainability of current consumption levels and patterns (see Assadourian 2010; Kemper and Ballantine 2017; and Little et al. 2019). While analytical assessments of problems certainly assist in realising how they could be solved, attention to ways that could solve or at least target solutions to the problems are also welcome. This chapter has approached such ambitions from a systemic, people-centred perspective by examining the visions of sustainable futures that people have authored in engagement projects. These visions constitute citizen agendas for the European research and innovation agenda, in general, and sustainable innovation, in particular. Open research agenda setting has a high priority in the preparations for the next European framework programme for research and innovation (European Commission 2017), which is supported by the results of this chapter.

The concept of sustainable innovation, i.e. innovation which contributes to sustainable futures, becomes in the visionary processes defined and contextualised by citizens. Citizens focus on systemic resources such as energy and production when they see innovation as a direction towards sustainability. New food markets and farming innovations further accentuate the citizen take on sustainable innovation. By contrast, education, which is a competing approach for citizens to embrace the future, is less accentuated in this context. Further, community-driven and social agendas are not predominant in citizen takes on sustainable innovation, which challenges the concept of social innovation (see Avelino et al. 2017; Cajaiba-Santana 2014). Indeed, the concept of sustainable innovation is something quite distinct from social innovation when people consider the future. These results confirm that the rationale for inviting people to contribute to open agendas also works in focused contexts.

Citizen insights provide a genuine contribution to the governance of sustainable innovation, and this contribution differs from that of experts and vested interests that typically influence innovation agendas (Repo and Matschoss 2019). Furthermore, citizen insights also build public support for the governance of sustainable

innovation. Such public support may be crucial when attempting to achieve societal targets that go beyond the adoption of sustainable innovations. Governing systemic changes and transitions can indeed be seen as prerequisites for achieving greater societal and environmental sustainability (see Köhler et al. 2019).

The analysis further shows that citizen involvement studies can benefit from the application of methodologies developed in natural language processing and machine learning. Methodologies such as topic modelling make complex and large data sets more approachable in research, which can be problematic in established qualitative and quantitative research procedures (see Repo et al. 2017). When doing so, citizens may also become more established and empowered system actors (cf. Hogg 2018).

Appendix 1: Citizen Vision 'Urban Farming' (Kaarakainen et al. 2015)

Urban farming means farming on the roofs, balconies and gardens of urban cities. This would bring all spaces of cities into beneficial use. For houses with flat roofs, solar panels could be used as roofs and the greenhouses would be situated underneath them. Urban farming would bring more vibrancy and nature into urban environments. In addition, urban farming would create carbon sinks, which are needed in urban environments; it would contribute to local food production, and commit people to communal local activity, which transcends generations. Composts and geothermal heating would be utilised in order to get the needed energy for farming. Communal farming would increase sense of responsibility of common issues at the local level and it would create a sense of 'we are together' spirit, for example, in housing cooperatives and urban neighbourhoods. Farming would also have an important learning aspect, because it would bring issues related to nature and food production into the awareness of children and other groups living in cities and into their use. Efficient promotion of urban farming is related to dismantling of unnecessary regulation ('bureaucracy') at the level of municipalities. Urban farming should be taken into account in construction planning, regulations and new construction production. The needed resources would be secured by selling the products of farming.

The benefits include decrease in dust and pollution, decrease of shortness of breath (including asthma symptoms), and protection of immunity (as a result of 'playing with soil'). This would be beneficial for all and it would decrease the costs of health care. The benefits include also increase in local food production (including beehives resulting in honey). The products would be genuine local food, which could be sold to kindergartens, elderly people's centres and schools. Children would become familiar with plans and herbs (e.g. by studying and tasting them). Urban farming would result in increase in social activity and sense of community at the local level. Farming would be relatively easy to organise, because in a densely populated city there would always be someone with time to take care of the farming.

Farming would not require new spaces. They would be accessible for different groups such as elderly people, families and physically disabled people. Urban farming would decrease costs and emissions related to transport—local food production would not require movement to hypermarkets located far away, but would in contrast decrease needs to make groceries far away from one's home. Urban farming would not require commitment to regulation related to organic farming.

We did not find any evident negative repercussions of this future. There are some problems related to organising sufficient supervision. It is a risk that somebody destroys the farming plants, if supervision is not sufficient.

Efficient promotion of urban farming is related to dismantling of unnecessary regulation ('bureaucracy') at the level of municipalities. The opportunities for urban farming should be taken into account in construction planning, regulations and new construction production.

Urban farming requires that people are together responsible for common, local issues: e.g. that no one destroys the products of farming. Farming also requires active citizens and voluntary organisations who are interested in farming. Incentives for urban farming include opportunities to employ people to activities related to farming, e.g. companies could rent out more space for farming. Residents and shareholders of housing cooperatives could be required to participate in active farming in order to be able to receive benefits related to it.

If activity is based on voluntariness, enough attention should be paid to maintain continuity. It may be problematic to maintain people's enthusiasm to participate in urban farming. Continuity and enthusiasm would be, however, important in order to raise children to take into account sustainable development. On the other hand, not all plants require active care—these kinds of plants could be located at the gardens and balconies of more passive citizens. A coordinator who is responsible for the urban farming in a city would also be necessary.

Appendix 2: Topical Distributions of Citizen Visions Expressed in Percentages According to the Three Examined Projects

Appendix 2: Topical Distributions of Citizen Visions Expressed in Percentages According to the Three Examined Projects

	System resources	Developmental education	New food markets	Farming innovations	Costs and benefits	Treatments	Production	Improvements	Collectives	Common cures
CASI	48.3	19.1	13.3	4.8	9.3	0.9	0.8	0.7	0.0	0.4
Cimulact	31.4	41.0	0.3	0.1	2.2	1.0	1.2	1.2	7.5	2.9
Civisti	21.8	33.2	0.0	0.1	10.6	1.1	2.2	0.3	0.0	0.2

	Intergenerational concerns	Accomplishment	Communities	Arts	Solutions	Peoples channel	Science	Technodreams	Business restraints	Infrastructures
CASI	0.0	0.5	0.7	0.0	0.3	0.1	0.0	0.2	0.0	0.3
Cimulact	2.6	2.0	1.6	1.7	1.5	0.4	0.0	0.1	0.3	1.1
Civisti	0.0	0.5	0.1	0.0	0.7	13.2	7.9	4.0	2.7	1.3

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Chapter 6
Stakeholder Engagement as a Tool to Support Sustainability-Oriented Innovation in the Public Sector

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Abstract The adoption of a stakeholder engagement perspective when studying sustainability-oriented innovations in the public sector allows to appreciate how different groups of stakeholders may contribute to the creation of these innovations, and what are the channels and instruments through which it occurs. This study relies on the case of one such innovation implemented in the Northern Italian city of Milan—the Congestion Charge Zone (Area C)—to provide a better understanding of the dynamics which allow the innovative process to benefit from stakeholders' contribution. The analysis suggests that Area C may in fact be seen as the result of a stakeholder co-creation process involving the main innovation promoter, Milan's Municipality, and its internal and external stakeholders. Both types of stakeholders are found to be involved in a collaboration process that fosters knowledge mobilization and, in turn, is reinforced and fuelled by it.

6.1 Introduction

Sustainability-oriented innovations (SOIs) have gained increasing attention in the past decade, further reinforced by the adoption of the 2030 Development Agenda by the General Assembly of the United Nations in 2015. The 17 goals that are part of the Agenda constitute the path envisioned by the UN for the pursuit of a sustainable development at the global level, including a critical role to be played by collaborative endeavours (Schaltegger et al. 2018). In fact, as sustainable development involves taking different scales and multiple stakeholders into account (Martens 2006), it requires a pluralistic approach that allows interaction with multiple actors at multiple levels (van Zeijil-Rozema et al. 2008). On the other hand, the adoption of a

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perspective that draws on the clout of collaboration is not new to the public sector, where partnerships and multi-actors' networks have already gained a reputation for being a more effective way of dealing with "wicked problems" (Koppenjan and Klijn 2004; Sørensen and Torfing 2011) when compared to efforts led by individual organizations.

In this context, effectively engaging stakeholders in the design and/or implementation of sustainability-oriented initiatives becomes of critical importance. The forms and instruments of such engagement, however, may vary according to various dimensions, and are likely to have different costs and results. This chapter aims at exploring how such forms and instruments may take shape in the case of sustainability-oriented initiatives that are innovative; a related objective consists of providing a better understanding of the dynamics which allow the innovative process to benefit from stakeholders' contribution.

In order to reach this objective, this chapter relies on the analysis of an SOI implemented in the Northern Italian city of Milan: the Congestion Charge Zone, called Area C. Area C is a system of mobility governance and management introduced in January 2012 to discourage the use of private vehicles in favour of public transport. It works by regulating motor vehicles' access to the central Limited Traffic Zone of Milan through a road pricing system, with vehicles being automatically recognized by a network of cameras. This case was shown to be a good practice of innovation by the EU funded CASI project (Public Participation in Developing a Common Framework for the Assessment and Management of Sustainable Innovation)[1]. More specifically, it was proved to address all the three main dimensions of sustainability, i.e. the economic, environmental, and social. In fact, Area C brings to the Municipality considerable financial gains that are used to finance other sustainable mobility projects; moreover, the project has contributed to improve the city's environment, thanks to reductions in air pollution and traffic congestion; and, as a consequence of these financial and environmental benefits, it contributes to enhancing the quality of life of the citizens.

The chapter is organized as follows. The next section reviews the literature on stakeholders' management and engagement, with a focus on the role that these activities may play for sustainability-oriented innovations. The subsequent section outlines the methodology used to conduct the study of the case, and is followed by a description of Area C, its origin and main characteristics. The fifth section presents the results of the analysis: it highlights how Milan's Municipality initiated a process of stakeholder engagement that included primary and secondary stakeholders at different levels, who contributed to the innovation process in their own peculiar way. The last section points to a process of knowledge mobilization that was enabled by stakeholder collaboration but also contributed to reinforce it, thereby fuelling a mutually reinforcing process that leads to stakeholders' co-creation of the SOI.

[1] http://www.futuresdiamond.com/casi2020/casipedia/cases/area-c-congestion-charge-in-milan/

6.2 The Role of Stakeholders for Sustainability: Sustainability-Oriented Innovation

The role of stakeholder engagement for corporate sustainability and sustainable innovation has increasingly received attention (Schaltegger et al. 2012; Ayuso et al. 2011), with some authors considering stakeholders and innovation at the heart of the transition towards sustainable business practices (Goodman et al. 2017). According to stakeholder theory, a stakeholder is any group or individual who can affect or is affected by the firm's objectives and activities (Freeman 1984). It is possible to distinguish between internal stakeholders, who are institutionally embedded in the organization (e.g. employees), and external stakeholders who are not institutionally embedded (e.g. local communities, Civil Society Organizations and government) (Ayuso et al. 2011). Once the relevant stakeholders have been identified, strategies need to be developed in order to manage or engage them (Ayuso et al. 2006). In this perspective, stakeholder theory may be adopted as a framework to identify and engage stakeholders in SOIs (Goodman et al. 2017; Ayuso et al. 2006). As they encompass economic, social, and environmental issues in a long-term view, SOIs need to consider a wide range of stakeholders who advance their different, and often contradictory, demands (Hall and Vredenburg 2003; Goodman et al. 2017; Ayuso et al. 2011). By integrating different stakeholders in the innovation processes, organizations can control and mitigate the risks and complexities of sustainable innovation processes (Hansen et al. 2009; Sloan 2009). Whereas extensive attention has already been given to primary stakeholders, for instance in terms of employees' commitment, customer engagement or suppliers' involvement, secondary or external stakeholders have recently been evidenced as a potential source of innovation (Ayuso et al. 2011; Hall and Vredenburg 2003; Goodman et al. 2017). Secondary stakeholders may play a fundamental role in ensuring the organization's legitimacy and the acceptance of the innovation and its results (Ayuso et al. 2006). As for the management of the relationship with stakeholders, the traditional approach based on risk mitigation and control appears to be ineffective in the pursuit of sustainable innovations, as it leads to a passive involvement of stakeholders, which, in turn, reduces the opportunities for effective organizational changes, innovation, and value creation (Sloan 2009). In fact, several studies have emphasized the role to be played by a more collaborative and proactive approach that advocates the use of concepts like "stakeholder engagement", "stakeholder integration", "stakeholder collaboration", and "stakeholder co-creation"; this highlights the importance of collaboration activities for creating shared value and achieving common goals, rather than the term "stakeholder management" that implies control of the interactions with the aim of risk mitigation (see e.g. Ayuso et al. 2011; Goodman et al. 2017; Kazadi et al. 2016). According to this perspective, stakeholders are conceived as a potential source of opportunity for collaborative innovation and sustainable growth. Thus, the collaborative approach explains how to enhance collaborative stakeholder engagement through communication and dialogue, collaboration, partnering, and learning (Sloan 2009; Goodman et al. 2017). This model is

argued to be more effective because of its ability to stimulate innovation and transformational change (Sloan 2009).

The innovation literature also converges on the idea that collaboration with a diverse range of stakeholders is an essential condition and a potential driver of innovation processes (Goodman et al. 2017). Nowadays the concept of closed innovation based essentially on internal R&D and competences is not enough to face the complex challenges of a rapidly changing environment. Thus, innovation has gone through evolutionary steps from closed innovation to new paradigms like open innovation (Chesbrough 2003); user innovation (Von Hippel 2009); open collaborative innovation (Baldwin and Von Hippel 2011); and co-innovation (Lee et al. 2012). All these paradigms require that the organization becomes more open and collaborative with both its primary and secondary stakeholders (Goodman et al. 2017). Moreover, sustainability-oriented innovation is increasingly conceived as more open and collaborative than traditional innovation, with recent studies agreeing on the importance of stakeholder collaboration activities to enhance the organization's innovative capacity and its sustainable innovation orientation (Adams et al. 2016; Klewitz and Hansen 2014; Ayuso et al. 2011).

Collaborations in innovation processes range from simple initiatives aimed at collecting stakeholders' suggestions during the decision-making processes (Luyet et al. 2012), to more active involvement and promotion of creative stakeholders' activities, which need to be facilitated by the innovators (Piller et al. 2011; Goodman et al. 2017). Collaborative stakeholder engagement can benefit SOI as well as the innovator for different reasons. The integration of different voices and perspectives in the innovation process facilitates a better understanding of the local context with its social needs and natural environmental problems, and the anticipation of market opportunities in a rapidly changing business environment (Ayuso et al. 2006, 2011). Due to the complexity of sustainability-related problems, no one organization alone possesses the necessary resources and knowledge-intensive competencies to solve them. By developing mutual and trust-based relationship with stakeholders, organizations may compensate their lack of resources through access to new and complementary information sources and knowledge bases to support SOIs (Bos-Brouwers 2010; Hansen et al. 2009; Adams et al. 2012; Kazadi et al. 2016). The involvement of committed internal and external stakeholders may enhance problem-solving capacity and generate new innovative solutions that benefit both the firm and the stakeholders, and contribute to sustainable development (Ayuso et al. 2006, 2011). When stakeholders actively contribute to the creation of new sustainable products or services, their acceptance becomes easier and less risky because they are more likely to better address stakeholders' expectation and social needs. Another benefit of collaborative stakeholder engagement concerns gaining and enhancing the legitimacy of SOI activities within shared goals and criteria for assessing innovation outcomes (Adams et al. 2016; Desai 2018; Achterkamp and Vos 2006). Mutual and trust-based relationships, reputation, ideas, and knowledge are examples of valuable and non-substitutable intangible resources that potentially lead to new SOI opportunities (Ayuso et al. 2006, 2011).

Within this literature, Ayuso et al. (2011) stress the role played by knowledge transfer and knowledge management for sustainability-oriented innovation processes. More specifically, they show that knowledge obtained from engagement with internal and external stakeholders contributes to the sustainable innovation orientation of the 656 companies covered by their study, but that this knowledge needs to be managed internally by the company in order to be beneficial for the innovation process. In fact, they stress that "a firm may be able to access useful knowledge located in diverse stakeholders groups, but not enhance its innovation if it does not have enough capacity to absorb such new knowledge and integrate it into its innovation processes" (Ayuso et al. 2011). Whereas Ayuso et al. (2011) conducted their study in a private sector context, we believe that knowledge-related processes and learning may play an important role also in SOIs that are promoted and/or implemented by public sector organizations, often in cooperation with other, non-public actors.

6.3 Method and Data

The analysis is based on an exploratory case study, with the main research setting being the Department of the Municipality of Milan in charge of the Congestion Charge Zone. The research was extended to two public organizations which contribute significantly to the functioning of Area C: AMAT, Agenzia Mobilità Ambiente e Territorio (Agency for Mobility, Environment and Land), owned by the Municipality and in charge of providing technical support for project implementation; and ATM, Azienda Trasporti Milanesi (Milanese Public Transports), a public company in charge of the management of Milan's public transports, and of Area C's technological management.

Area C provides an example of the innovative approach that characterizes Milan's Sustainable Mobility strategy. It is a system of mobility governance and management introduced in January 2012 in the form of a structural measure, which aims to discourage the use of private vehicles in favour of public transport. Area C regulates motor vehicles' access to the central Limited Traffic Zone of Milan through a road pricing system, based on automatic recognition of vehicles through cameras. The choice of this case is linked to Area C being shown to be a good practice of innovation by a study conducted within the CASI project. The innovativeness of Area C is also confirmed by two awards which were both granted in 2014. The OECD's Transport Achievement Award 2014 was assigned to Area C in the month of May, highlighting the political courage to replace the previous pollution charge, which was no longer able to achieve its goals, with a more effective measure aimed at enhancing its positive effects. The National Award for Innovation was granted in September of the same year by the Italian National Foundation for Technological Innovation COTEC.

The main sources used for the analysis consist of semi-structured interviews with key individuals involved in the Area C project, conducted in the years 2015 and

2016 as part of the above-mentioned CASI project. These were accompanied by the analysis of unpublished reports and internal documents supplied by the Municipality, and by the publicly available literature on Area C and on Milan's Mobility Strategy.

6.4 The Establishment of Milan's Congestion Charge Zone

Area C covers the central Zone 1 around Milan's historical centre, equal approximately to 8.2 square kilometres. Vehicles are charged for access on Mondays to Fridays from 7.30 am to 7.30 pm, except Thursdays, when they are charged from 7.30 am to 6 pm. Access is allowed through 43 points, including seven for the exclusive use of public transport, and are monitored by cameras. Vehicles entering the Zone are detected by the cameras, and their licence plate data is communicated to a system which allows recognizing the vehicles, their classification (e.g. residents) and the matching due charge. The general and most common charge is €5: the ticket can be purchased at parking metres, newsagents, tobacconists, ATM points, at the cash machines of IntesaSanpaolo branches, online (www.areac.it) or by calling a dedicated call centre and at garages which have set an agreement with the Municipality. The following vehicles are exempted from payment: electric and hybrid vehicles, motorcycles, and natural gas, LPG and bi-fuel vehicles. Vehicles transporting people with disabilities or exposed to life-saving treatments, as well as vehicles directed at emergency rooms at hospitals located within Area C are also exempted. Residents of the central Zone 1 are allowed 40 free entrances per year, with every subsequent entrance charged at €2.

As stated by the Municipality itself, the main purpose of Area C is to improve the living conditions of those who live, work, study in and visit the city. More specifically, its objectives are[2]:

- Reduce road traffic within the city centre
- Improve public transport networks
- Raise funds for soft mobility infrastructures, e.g. cycle lanes, pedestrian zones, 30 km/h zones
- Enhance citizens' quality of life by reducing the number of accidents, uncontrolled parking, noise and air pollution

Area C evolved from a previous scheme, called Ecopass, introduced in 2008 by the then ruling centre-right Administration as a pollution charge. The scheme run from 7.30 am to 7.30 pm Monday to Friday, and all vehicles entering the area had to pay a pollution charge, proportional to their emission class. The Ecopass system was based on the assumption that the responsibility for emission externalities varies

[2]See Municipality's website at https://www.comune.milano.it/aree-tematiche/mobilita/area-c#navpageinside

among vehicle categories. Class 1 and 2 vehicles were exempt from the charge, class 3 vehicles were charged €2, class 4 were charged €5 and class 5 (largely commercial vehicles) were charged €10. Vehicles subject to the charge amounted approximately to 50% of circulating vehicles (apart from those exempt), though a provisional exemption was also set for diesel cars Euro 4 without particulate filter (covering about 10% of circulating vehicles) which was prolonged over time. The actual chargeable vehicles in the base year, before implementing the charge, were approximately 42% of the total. In the first month of implementation, charged vehicles amounted to 25,3% of vehicles entering the area; they progressively dropped to about 10% in 2011 (Croci and Ravazzi Douvan 2016).

Ecopass was successful at the outset, as it caused a reduction in congestion and car emissions, but the effect on congestion progressively decreased as more and more people replaced their older polluting vehicles with new cleaner ones. As the Administration was reluctant to change the system towards a more restrictive one, a citizens' committee, called MilanoSiMuove, promoted a referendum, which included one question on the future development of Ecopass. The question explicitly tested the citizens' attitude towards a charge to be paid by all vehicles, and the result was clearly in favour of the change (Croci and Ravazzi Douvan 2016). The referendum took place in June 2011, at the same time as municipal elections that resulted in a new centre-left Administration, which carried the reform forward. This set the way for the Area C congestion charge—with a flat charge of €5—to replace the Ecopass pollution charge, beginning 1 January 2012.

Area C: Process and Actors

While Area C took advantage of the existing infrastructure—the cameras, the automatic plate recognition system, and so on—the rationale and the operating system were to change considerably relative to the previous Ecopass. The new system was established through a very intense and rapid planning phase—4 months overall, as stated by interviewed members of the team that took part in this phase—which was then followed by implementation and progressive evolution.

The leading role was played as expected by the Municipality, and particularly by the Central Directorate for Mobility, Transport, Energy and Environment, with an important role also played by the Office of Communication, both internally to sustain adhesion to the project, and externally to conduct communication and information campaigns for the benefit of Milan's citizens. More specifically, the Central Directorate for Mobility, Transport, Energy and Environment is in charge of the following:

- Overall planning of Area C
- Management of the contract with the public agency (ATM) in charge of payments
- Management of the back office and front office of Area C
- Involvement in EU-financed or national projects for sustainable mobility, experimentation with other mobility projects (including bike and car sharing, cycle lanes, 30 km/h zones, etc.)

During the design phase, four cross-departmental working groups were created, so as to share relevant knowledge and needs to be taken into consideration; these working groups were covering the following areas, respectively: Road signs, Information systems, Legal, and Communication. The Municipality of Milan also carried out discussions with the Municipality of London, so as to draw insights and lessons from the experience of the local congestion charge. The Government of the Lombardy Region was also involved in the design phase to evaluate the transition from the old Ecopass system to the new congestion charge.

Two additional key public organizations were involved both in the planning and implementation phase: AMAT and ATM. AMAT is responsible, on behalf of the Municipality, for the collection and analysis of the data used to monitor the environmental impact of Area C. During the design phase particularly, AMAT worked in partnership with SIMG (the Italian Society of General Medicine) as well as with experts at Cornell University (Ithaca, NY) and at the University of Southern California Los Angeles, who provided technical and scientific support for the definition of the relevant indicators and methods for the assessment of the environmental impact of Area C. More specifically, AMAT carries out field analysis and monitoring in order to produce data and maps; develops models, simulations, assessments and feasibility studies; provides comparisons with relevant international experiences; develops tools for planning, programming documents, and integrated projects; and provides the Administration with the necessary technical support during the implementation phase. Within the ATM group, ATM Services is the division in charge of the management of Area C as far as the provision and continuous update of the relevant technologies are concerned, including payments' settlement.

The Area C project, then, was designed and implemented by a partnership of three separate organizations: AMAT, ATM, and the Municipality of Milan with its relevant internal Departments, with a leading and coordinating role played by the latter. The whole initiative, however, was far from a top-down process imposed on citizens. The Municipality took particular care in involving citizens and other stakeholders throughout, based on the belief that such involvement would benefit the Administration's reputation and, most critically, the success of the project itself. In addition to the June 2011 referendum, which had clearly shown the city's general support, the Municipality organized nine workshops with representatives of categories who were likely to be affected by Area C in specific ways, including residents of Milan's central area, owners of garages located within Area C (who were likely to experience a reduction in business), business associations whose associates needed to enter the Area C for goods' delivery, other public organizations located outside of Area C (whose duty vehicles might need to enter the area and could expect to be exempted from the charge because of their public nature) and so on. The Municipality and ATM also invested in the development of their social media profiles, particularly Facebook and Twitter, as a fundamental channel to interact with citizens and address their questions and concerns.

Impact and Sustainability Assessment

Area C has been able to spawn significant economic returns, which allowed to support further investment in other projects. Specific projects which benefited from Area C's earnings include: (i) a new Park and Ride serving the Line 3 subways; (ii) the improvement of the bike-sharing system with the expansion of the bike-track network and the introduction of electric bikes; and (iii) the enhancement of public transport in terms of both modernization and increased frequency. The Municipality's Chief of the Division in Charge of Area C also reported positive returns in terms of the Municipality's image and perceived reliability at the local, national and international level. Employees of the Municipality have also acquired new skills in the management of complex and dynamic processes.

Moreover, Area C is subject to rigorous monitoring with respect to its economic, social, and environmental effects. The results of this monitoring and evaluation process are only partly publicly available and published through periodic reports in a special section of the Municipality's institutional website. Published indicators include measures of: traffic flows within and outside Area C, speed of public transport, accidents, traffic emissions, and black carbon presence. These allow an assessment of environmental performance through the analysis of PM10 Exhaust, PM10 total, ammonia, total nitrogen oxides, nitrogen dioxide, volatile organic compounds (non-methane), which also allow to evaluate the impact of Area C on citizens' health. Interactive reports based on certain data, such as daily or hourly access, can also be downloaded from the municipality's Open Data portal. The data do indeed show improvements, in the level of traffic as well as pollution. For instance, in the year 2017, the average daily number of vehicles entering Zone 1 decreased by 7.2% relative to the previous year; as compared to the year 2011—when the previous Ecopass system was in place—the decrease reaches 35.5% (AMAT 2018). As for the emissions, data show that, for instance, PM10 Exhaust have diminished by 66% in 2015 relative to 2010, with considerable reductions also in relation to other indicators over the same period, such as PM10 total (−42%), ammonia (−43%), and nitrogen oxides (−37%) (AMAT 2016). The Municipality also gathers data on the project's revenues and costs, but these data and related reports are not publicly available.

6.5 The Role of Stakeholder Engagement in the Area C Innovation Process

This case is an example of how different categories of stakeholders were successfully involved in the innovation process by the multiple actors who were involved at various stages.

For instance, Milan's citizenry was involved in the process even before the beginning of the design phase: the June 2011 referendum was a critical tool to corroborate the citizens' predisposition towards a new system, to be built on the

existing Ecopass, but meant to be more burdensome. The results of the referendum confirmed that the citizens were willing to carry on with the reform, with the related shape and rules left to be defined to the subsequent phases.

The design phase took place during the second half of the year 2011, with a substantial though informal coordination role played by the Director of the Municipality's Central Directorate for Mobility, Transport, Energy and the Environment. The wish to launch the project within the first 100 days of the new municipal Administration, together with the strong support by the new Alderman for Urban Mobility, fostered commitment within the Municipality, which facilitated and promoted intense collaboration with internal stakeholder, i.e. those within the Municipality itself and within ATM and AMAT. Municipality employees who had previously worked within the Ecopass team provided information about the previous system; new employees were also involved in the project as a result of the changes brought about by the new centre-left Administration. In order to produce the technical knowledge that was needed for the operational and political implementation of Area C, AMAT engineers worked internally and through collaborations with Cornell University and the University of Southern California Los Angeles. A specific role in this phase was also assigned to the Municipality's Communication Office, which was in charge of effectively and clearly disseminating information about the new system to Milan's citizens and city users, and especially to the stakeholders who were likely to be more affected, including individuals and business owners residing within the Area C itself. Once the system was put in place with a basic set of rules, citizens and stakeholders who believed they had a legitimate claim for exemption began to request it. Each request was formally taken into consideration, so as to ascertain whether it was based on a general interest—and therefore worthy of being included into the Area C set of rules—or not, and therefore destined to rejection. Whereas this evaluation process was initially carried out on a case by case basis, it was later institutionalized and made into a more standardized process.

In the design phase, most of the stakeholder engagement effort carried out by the Municipality involved internal stakeholders: this included its own employees, but also personnel at AMAT and ATM who are strictly external to the Municipality but may still be considered part of the core group of municipal level organizations which set the project going. Four specific working groups were established within the Municipality on Road signs, Information systems, Legal, and Communication to meet weekly with individuals from ATM and AMAT, so as to advance the project from an operational and technical viewpoint. Municipal and AMAT employees also held meetings of a more political nature with various types of stakeholders, including residents of the most affected central Zone 1 of the city, public sector organizations, retailers, the police, and so on. These meetings aimed at providing scientific and transparent answers and data, but also to ensure that citizens would not get excessively dissatisfied with the current Administration because of the inconveniences caused by Area C.

In summary, the three core public organizations—the Municipality, AMAT, and ATM—were able to use the design phase to fruitfully engage their internal stakeholders, who were essential owners of technical and experiential knowledge.

Stakeholders who were external to these three core organizations began to be more frequently and intensively involved during the subsequent project implementation phase. The actual working of the Area C system brought to light unforeseen problems or enquiries, together with protests by citizens who had begun to use the system, which triggered a collective process of knowledge transfer and learning. Over time, the public employees involved in the project began to use new tools to interact with citizens and other stakeholders, moving from email and dyadic/group interactions to apt use of social media and more structured engagement meetings. For instance, given that a few large hospitals are located within the central area of Milan, decisions had to be taken in terms of which types of patients, if any, were to be allowed free access to the area. Meetings were organized with hospital physicians and with the regional committee in charge of disability certifications, so as to ascertain which illnesses implied mobility difficulties, even if the patient was not entitled to the official and permanent disability permit for their car. The result of this co-decision process was that individuals going to hospitals' delivery room or to the morgue for close relatives were to be granted exemption, but blood donors, for instance, were not. As for the interests of the owners of garages located within the area itself, the Municipality agreed to reduce the charge to €3 instead of €5, as long as the coupon is purchased at the garages themselves and is linked to a stay of at least 4 h.

In this phase, critical for the implementation of the Area C project was the distributed organizational capability to integrate the knowledge dispersed among the various stakeholders. In this respect, the Municipality's Division in Charge of Area C and Mobility Projects succeeded in fostering stakeholders' commitment and integrating individual knowledge and ideas, thereby institutionalizing the collective contribution to the innovation itself.

Once the implementation of Area C was well under way, the Municipality began to focus on innovation, simplification, and management control, and to find new and effective ways to use the revenues from Area C for other sustainable mobility projects. This led to a significant learning process and acquisitions of new competences, including those related to how best interact with citizens. Thanks to the Area C project, the Municipality's Division in Charge of Area C has also established new ways to collaborate with other parties, such as the local police in those cases where, for instance, a sanction was wrongly issued because of a system malfunction. Area C's success and the general collaborative attitude have also fostered new opportunities for cooperation with local businesses, including freight forwarders who initially opposed Area C, but later became strong supporters because of the benefits in terms of lower traffic in the city centre. Among citizens, the success of Area C, and the participatory way in which it was implemented, contributed to the increase of trust towards the Municipality, and lowered the perception that the public sector tends to be rigid and inflexible.

6.6 Stakeholder Engagement as a Channel for Knowledge Mobilization

By engaging different categories of stakeholders from the early stages of the innovation process, the Municipality of Milan was able to set in motion a process of "knowledge mobilization" which was critical for the implementation of the Area C project (Trivellato et al. 2019). The stakeholders' responsiveness and participation was driven by different motives, ranging from a vigorous political drive connected with the recent municipal elections, to the enthusiasm of public employees willing to see the project up and running, to the satisfaction of citizens seeing their voice heard and taken into consideration. This bolstered a strong commitment and the willingness to get the project going despite the difficulties and the sometimes conflicting interests of the stakeholders involved. In their analysis of the Area C project, Trivellato et al. (2019) suggest that these processes of stakeholder engagement and their results have enabled three knowledge-related organizational capabilities—knowledge creation and absorption, knowledge integration, and knowledge reconfiguration (Verona and Ravasi 2003)—and further promoted their development and reconfiguration. In this way, these processes have also reinforced the Municipality's capacity to innovate—and to fuel collaborative innovation—in the longer run. In fact, according to Trivellato et al. (2019) "even if knowledge creation and absorption may be prerequisites for the innovation to be set in place rapidly, what allows the dynamic process of its continuous evolution is the leaders' capability to support the capturing and integration of the knowledge that happens to be dispersed among the various stakeholders. This capability rests on a flexible project-based organization that promotes adhesion and commitment on the part of those involved within and outside the participating organizations, supports the capacity to tap individual knowledge and ideas, and institutionalizes the collective contribution to the innovation itself". The Municipality was able to establish a structure that allowed flexibility in the redefinition of roles, relational patterns, and rules; this facilitated collaboration at the inter-personal and inter-organizational level, and also the recombination of the resources held at those different levels. The positive impact on the collective ability to produce innovations became manifest, for instance, in the increased capacity to generate multiple solutions for existing needs (as in the search for new payment methods for the Area C charge), and also to develop new services within Milan's Sustainable Mobility Strategy more generally.

A key role for effective stakeholder engagement is then played by a figure which Trivellato et al. (2019) call "the 'knowledge orchestrator': an actor—or group of actors—assuming different leadership roles at different times, as s/he strives to create value through knowledge mobilization. The knowledge orchestrator features the ability to leverage from existing material and immaterial resources, capture external demands and stimuli, and promote collaboration among individuals and institutions, and—in the process—sustain knowledge creation and absorption, knowledge integration and knowledge reconfiguration" (p. 321). In other words, "the knowledge orchestrator integrates the contributions of various stakeholders in a

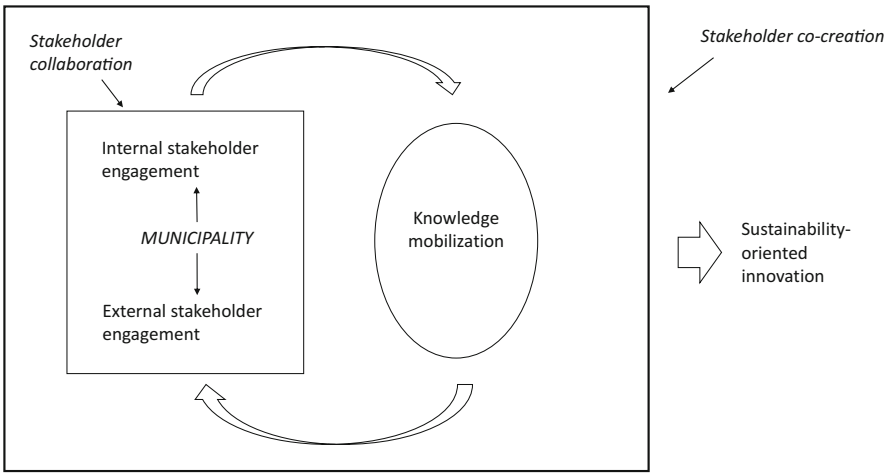

Fig. 6.1 SOIs as a result of stakeholder co-creation

coherent whole, in a way that enables further development of that knowledge" (ibid.).

Moving from our previous study, in this work we highlight the existence of a mutually reinforcing process between stakeholder collaboration, enabled and promoted by the Municipality, and knowledge mobilization (see Fig. 6.1).

By engaging both internal and external stakeholders, the Municipality plays a leading role as part of the above-mentioned "knowledge orchestrator" (Trivellato et al. 2019) and therefore as a propeller of a collective learning process. At the same time, the knowledge mobilization processes and related learning increase the awareness by all parties of the benefits of the Area C project, and especially of contributing directly to its design. This, in turn, reinforces the stakeholders' commitment to participate in the innovation process, thereby allowing the Municipality to bring fruitfully forward the stakeholder engagement process.

We may then refer to the results of this engagement as "stakeholder collaboration", which acts as enabler of knowledge mobilization and is further reinforced by it, as explained earlier. This mutual reinforcing process may in turn be labelled "stakeholder co-creation" by adapting a concept originally developed by Kazadi et al. (2016). The term "co-creation" is here used to emphasize that it is precisely the collaboration among diverse stakeholders that allows knowledge mobilization to take place and, in turn, the Area C innovation to take shape.

The study of Area C confirms the role played by stakeholder involvement and knowledge-related processes for SOIs, including—as noted by Ayuso et al. (2011)—the need to put knowledge mobilization to good use. Trivellato et al. (2019) show that, in the case of Area C, a critical role was played by several individuals (at different organizations) who assumed different leadership roles at different times. This work builds on the previous one as it suggests that the benefits for stakeholders from their active engagement need to be made visible, also in terms of

their ability to shape the innovation process and make sure that their needs and proposals are taken into consideration. This will also reinforce the reputation and legitimacy of local governments and public sector organizations, and therefore their ability to co-create subsequent SOIs.

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Part III
Management of Sustainable Innovation

Chapter 7
Fostering Sustainable Innovation: Insights from Three European Food Banks

Laura Mariani, Dario Cavenago, and Elisabetta Marafioti

Abstract Grassroots sustainable innovations are novel and sustainable solutions designed and developed by the actors of civil society in order to respond to local issues. Among them, several initiatives promoted by non-profit organizations aimed at reducing food waste are gaining growing attention. Focusing on three case studies of food banks across Europe, the goal of this chapter is to assess their business models so as to identify drivers that can support and favour the diffusion of such initiatives, in order to reduce the problem of food surplus in European countries. Specific attention is given to the role of public sector.

7.1 Introduction

Grassroots sustainable innovations are novel bottom-up solutions for sustainable development, designed by networks of activists and organizations that respond to the local situation and the interests and values of the communities involved (Seyfang and Smith 2007). In contrast to mainstream business greening, grassroots initiatives operate in arenas of civil society and involve committed actors experimenting with social innovations, often using greener technologies than businesses use (Seyfang and Smith 2007).

Among grassroots sustainable innovations, the diffusion of initiatives aimed at reducing food waste in western countries is gaining significant attention from public institutions. Around 88 million tonnes of food are wasted annually in the European Union, with associated costs estimated at 143 billion Euros (Stenmarck et al. 2016). Globally, food waste represents the third largest contributor to carbon dioxide emissions, with estimated costs of about US$940 billion (FAO 2013, 2014). In

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this field, goals of EU food safety policies concern both the prevention of food waste and the development of a sustainable food system. Consequently, across Europe, regions and cities are planning local initiatives to ensure food security and promote sustainable food systems, often through the implementation of food recovery policies (Brunori and Di Iacovo 2014).

At the operational level, these initiatives are primary promoted by non-profit organizations that manage food recovery and redistribution, and support the development of a sustainable public welfare system, according to a perspective of non-profit-government interdependency. The relationship between non-profit organizations and the public sector has been often a central topic in the political agenda of different countries. At the same time, this topic has captured the attention of scholars, interested in observing different partnerships' configurations across differentiated welfare regimes (Salamon et al. 2000), as well as in identifying governance and management mechanisms able to support these partnerships.

In this vein, the present chapter aims to identify factors that can lead to an improvement in government/non-profit relations by adopting the strategic perspective of business model analysis in the case of three food banks across Europe. In specific terms, this chapter aims to identify differences in the business models of food banks, so as to identify potential paths of development able to take into account the specific features of different types of organization.

This chapter is organized as follows: in Sect. 7.2 we review the most relevant literature in the field of grassroots sustainable innovation. In Sect. 7.3, we introduce the concept of business models, and business model analysis, adapted to the context of third sector organizations that promote food recovery initiatives. Section 7.4 sets out the methodology of our study and Section 7.5 presents the empirical analysis of the business models of three food banks across Europe. We discuss the process of diffusion of grassroots sustainable innovations in Sects. 7.6 and 7.7 concludes the chapter.

7.2 Grassroots Sustainable Innovations in the Field of Food Recovery

Surplus food is edible and safe food that, for various reasons, is not sold to or consumed by the intended customers, being deemed surplus at different stages of the food production chain (Garrone et al. 2014). Its recovery has become critical in order to increase global food security. According to the Food and Agriculture Organization of the United Nations (FAO), *"food security exists when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet dietary needs and food preferences for an active and healthy life"* (FAO 2009, p. 8). Despite some progresses having been made to reduce chronic hunger, the number of malnourished people in the world is still approximately 800 million. The problem of food security not only occurs in low-income countries, but also in

high-income ones. In particular, the contradiction between the everyday wastage of food and food poverty affecting a large section of the word population has become an important topic. Surplus food generation occurs at different stages of the production and supply chain. In low-income countries, in particular, it is concentrated at the stage of processing and is due to inefficiencies or changes in climate conditions. In contrast, in high-income countries, surplus food occurs at the level of retail and consumer, and it is due to marketing strategies, deterioration of food held in inventories, and incorrect forecasting of demand (Garrone et al. 2014). The consequences of waste of surplus food are significant and they include the increase of water consumption, the reduction of environmental resource use, and the generation of carbon dioxide. It also affects the economic system, as food has a commercial value, and has significant social consequences, contrasting with the worldwide spread of food poverty (Garrone et al. 2014).

In this field, different local level innovative initiatives have been designed and implemented, thanks to the action of the community and its civil society organizations. The identified solutions can be defined grassroots sustainable innovation. Seyfang and Smith (2007) define grassroots sustainable innovation as *"networks of activists and organizations generating novel bottom–up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved. In contrast to mainstream business greening, grassroots initiatives operate in civil society arenas and involve committed activists experimenting with social innovations as well as using greener technologies"* (Seyfang and Smith 2007, p. 585). Sustainable innovations are innovations that improve performance based on ecological, economic, and social criteria for the definition of such performance (Boons and Lüdeke-Freund 2013; Carrillo-Hermosilla et al. 2010). Since the ecological, economic, and social criterion may differ according to spatial, temporal, and cultural conditions, the concept of sustainable innovation can assume different meanings and characteristics in different contexts (Boons and Lüdeke-Freund 2013). Within the European Union, in particular, sustainable innovation initiatives are promoted by the 2030 Agenda for Sustainable Development that is the result of several previous political initiatives implemented since the launch of the EU Sustainable Development Strategy in 2001. The definition of sustainability does not include only the concept of environmental safeguarding, but also encompasses economic and social sustainability. Therefore, grassroots sustainable innovations are not exclusively those aimed at preserving nature (e.g. focusing on the transition to a low-carbon economy, climate resilience, efficient use of resources, and the circular economy), but also those aimed at the preservation and improvement of social cohesion and inclusion, as well as the development of responsible fiscal policies and reforms that strengthen the economic sustainability of welfare systems. When sustainable innovation initiatives arise from the bottom up in order to meet the perceived needs of a community, they are the result of grassroots innovation movements that seek socially inclusive innovation processes for the benefit of local communities in terms of the knowledge, processes, and outcomes involved (Smith et al. 2014).

7.3 A Frame for the Assessment of Organizational Activities: The Business Model Analysis

The process of value creation implemented by the organizations that promote grassroots sustainable innovations can be assessed through the dimensions of their business models.

From a strategic perspective, non-profit organizations select a specific segment of the external environment—whose characteristics depend on the institutional and social context—and they carry out certain types of transactions within it (Normann 1977). More specifically, the organizations select a specific task environment and choose the type of transactions to undertake there. Consequently, the complex environment, in which non-profit organizations operate, is characterized by different actors and interdependencies among them (Cavenago and Mariani 2017). At the same time, these interdependencies are the result of the organizational choices. Changes in regulation aimed at favouring the growth of non-profit organizations, may also incentivize, for instance, new approaches to business operations, improving the overall involvement of the community (Haddad 2011).

Within a potential environment, defined by institutional and societal context, the organizations develop their own business idea, translated into a specific social business model.

The study of business models received increasing attention from academics interested in understanding the contribution of organizations to the creation of value. According to Amit and Zott (2001), the business model describes *"the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities"*. From another perspective, they are "stories that explain how enterprises work" answering the following questions: *"Who is the customer? And what does the customer value? How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?"* (Magretta 2002). Mirroring the achieved organizational strategy (Casadesus-Masanell and Ricart 2010; Shafer et al. 2005), business models explain how organizational activities are run together, bridging strategy formulation and its implementation (Richardson 2008). More specifically, within a potential environment—defined by an institutional context and the societal characteristics—any organization develops its own business idea that has to be translated into a specific business model. The development of the organizational business idea requires the maintenance of a strong coherence between three different components: (1) the external environment and its needs; (2) the features of the services offered by the organization; and (3) internal factors such as organizational structure, resources, knowledge, and capabilities (Normann 1977). Although there is no common and extensively accepted definition of the term "business model", some common traits and concepts can be identified. A business model, in particular, is a distinct new unit of analysis centred on a focal organization, but its boundaries are wider; emphasizes a systemic approach to explaining how organizations perform their activities; and seeks to explain both value creation and

value capturing. Furthermore, the activities of a focal organization and its partners play an important role in the proposed conceptualizations of business models that have been proposed.

Although the research on business models considers mainly private for-profit organizations, a small number of studies are moving attention to the third sector. Among these, Seelos and Mair (2007) have studied value creation mechanisms in the context of deep poverty, conceptualizing a business model as a *"set of capabilities that is configured to enable value creation consistent with either economic or social strategic objectives"* (2007, p. 53). Thompson and MacMillan (2010) analyze the development of new business models that can lead to societal wealth improvements such as reduction of poverty and human suffering. Finally, Yunus et al. (2010) propose a framework for the assessment of the Grameen Bank business model, emphasizing the role of social value, which is particularly significant for social cooperatives. Using the label of *"social business model"*, Yunus et al. (2010) describe the business models of social enterprises that have the twofold purpose of generating social value whilst still maintaining profitability.

7.3.1 Assessing the Business Model Through CASI-F

Although there is no consensus as to the definition of business model, previous studies tend to distinguish its three major components: the product/service proposed; the way the company is organized so as to deliver this product or service to its customers; and the revenue frame that is able to finance expenses (Chesbrough and Rosenbloom 2002; Zott and Amit 2008). According to Yunus et al. (2010), these three components can be labelled: value proposition; value constellation; and profit equation.

Value Proposition

The value proposition of a for-profit organization is the implicit promise that a company makes to its customers to deliver a particular combination of values. In contrast, the value proposition of non-profit organizations, such as those that administrate food banks, relates to the needs of a wider range of stakeholders, focusing on the development of social innovation, and the accomplishing of representational activities (Salamon et al. 2000). The direct users of food bank services are mainly individual consumers who are in need and non-profit organizations that are engaged in food redistribution from factories or retailers.

Within the Common Framework for the Assessment and Management of Sustainable Innovation (CASI-F Framework, see Popper et al. 2017), information on the value proposition can be derived from the assessment of the aims of the innovation as well as from the assessment of the initiative's beneficiaries.

Value Constellation

Value constellation is the answer to the question "How do we deliver this offer to our customers?" (Yunus et al. 2010). The value constellation involves both the organization's own value chain as well as the value chain of the network that includes suppliers and partners. In this context, a key strategic task is the reconfiguration of roles and relationships among a constellation of actors—suppliers, partners, public administrations, and users—in order to mobilize the creation of value by a new combinations of actors, breaking down the products and services distinction and combining them into an offer that is activity-based (Normann and Ramirez 1993). Literature on non-profit organizations identifies three main categories of key partners that can be included in the value constellation: the public sector, private firms, and volunteers.

According to the interdependence theory (Salamon et al. 2001), collaboration between the public sector and non-profit organizations arises as a consequence of the mutual interdependence between the two sectors that together cooperate for a better and more efficient provision of public services. Several authors have studied the possible configurations of the relationship between non-profit organizations and the public sector. Young (2000) identifies three fundamental models: *supplementary*, *complementary*, and *antagonist*. In the *supplementary* model, non-profit organizations act in the public interest and meet the demand that is not met by public sector intervention; according to the *complementary* model, non-profit organizations are considered partners of the public body in the provision of services and public goods, which is widely financed by the government. Finally, in the *antagonistic* model, non-profit organizations are pressing for the change of public policies, while the government tries to influence the non-profit organizations' activities through regulation and controls. Furneaux and Ryan (2014) propose a framework that identifies six possible configurations of the non-profit-government relationship: *contempt*, *conflict*, *charity*, *contracting*, *cooperation*, and *concordance*. As we move from the contempt model to the concordance model, the degree of shared values and the alignment of objectives become stronger, while the asymmetry of power in favour of the public sector tends to reduce (Table 7.1).

Business–non-profit partnership is a widely explored topic of academic debate. According to Sanzo et al. (2015), interactions among these societal sectors have changed significantly over time, producing models of relationships that integrate competition and cooperation. In particular, new forms of collaboration emerge that go beyond the relationship between donor and beneficiary, traditionally adopted by private companies and non-profits. More specifically, the typologies of business–non-profit relationships can entail different degrees of relational development, ranging from corporate philanthropy, corporate foundations, licensing agreements, sponsorships, cause-related marketing, joint issue promotion, as well as joint ventures (Wymer and Samu 2003). As the relationship moves along this continuum, its features change in terms of increasing engagement, importance of the collaboration for the partner's mission, magnitude of resources, type of resources (ranging from money to core competences), scope of activities, interaction intensity, internal

Table 7.1 Non-profit-government relationships

Relationship	Description
Contempt	Destructive relationship of mutual distrust and aversion, with the government repressing the development of non-profit organizations through legislative power or coercion.
Conflict	Non-profit organizations exercise an advocacy function, in opposition to certain public policies.
Charity	Public funding does not constitute an instrument of control and influence; on the contrary, it reflects the characteristics of a charitable donation with which the government finances non-profit institutions that provide services independently.
Contracting	Government has the role of buyer, defines the terms and objectives of the contractual agreement that it stipulates with the non-profit, which becomes a service provider.
Cooperation	Arises from the spontaneous will of the parties, who wish to work together because they share the same objectives and values.
Concordance	Government renounces any attempt at control and influence, aligns public objectives with the strategic plan of non-profit institutions that finances and contributes to the development of the third sector.

Source: Authors' elaboration

change, managerial complexity, strategic value, co-creation of value, synergistic value, innovation, and external system change (Sanzo et al. 2015).

A significant body of research has assessed the factors that foster the development of successful relationship (Ballantyne et al. 2003), pointing to commitment and trust as the main dimensions able to explain the effectiveness of a relationship (Morgan and Hunt 1994). Finally, volunteers are crucial to the functioning of non-profit organizations (Weisbrod 1975). According to Salamon et., in particular, the presence of forms of voluntarism is a primary condition for non-profit organizations. In this vein, organizations must embody the concept of voluntarism to a significant extent by engaging volunteers in its management and operations, either on its board or through the use of volunteer staff and voluntary contributions. Furthermore, the concept of "voluntary" also carries the meaning of "non-compulsory". Organizations in which membership is required or otherwise stipulated by law would be excluded from the non-profit sector. Finally, "voluntary" implies that contributions of both time or money (donations) as well as contributions in kind cannot be required or enforced by law, or otherwise be openly coerced.

Within the CASI-F Framework, information on the value constellation can be derived from the assessment of stakeholders' contributions to the initiatives.

Profit Equation

The profit equation is the translation of value proposition and value constellation in terms of revenues, expenses, and social impacts. The need to fulfil the social mission whilst still maintaining a financial balancing is a precondition for the sustainable development of food banks. The stream of revenue of non-profit organizations,

including those in charge of the management of food banks, may include donations from private individuals and firms, as well as public sector support. Sometimes these sources can be further reinforced by ancillary commercial activities. With reference to the stream of expenses, those related to employees' wages and logistic are the most significant in food banks' value chains. With reference to the social impacts, Seyfang and Smith (2007) suggest that grassroots innovations can produce both intrinsic and diffusion benefits. One perspective values the niche for its own sake (intrinsic benefits), the other as a means to an end (diffusion benefits). The principal intrinsic benefit relates to the social and environmental basis of the niche. Direct environmental benefits of a grassroots innovation within the local community can be, for example, reductions in car use, increases in recycling practices, or planting trees. Within the same community, other second level intrinsic benefits emerge due to such environmental benefits, including job creation, training and skills development, and personal growth. At a third level, the positive spill over within the community can translate into an overall improvement in the sense of community, social capital and civic engagement, or better access to services and facilities (Devine-Wright and Devine-Wright 2006; Seyfang and Smith 2007). Diffusion benefits refer to the transfer of value created by niche innovators to the wider mainstream community. Within niches of sustainable innovation, in fact, the systems of provision, the organization of activities, and the relationships among actors may contrast with the conventional social and economic conditions. In such cases, grassroots innovators may seek to mobilize communities so as to create a new system with values that differ from the mainstream, thereby generating transformations in production–consumption systems in a way that individuals cannot achieve independently (Maniates 2002).

Within the CASI-F Framework, the main information on the profit equation concerns revenue streams. With specific reference to the concepts discussed in this chapter, we assess, in particular, the importance of both private donations and public sector contributions that make the business models of the assessed European food banks financially sustainable.

7.4 Methods

In order to fulfil the research aims, a qualitative multiple case study analysis has been conducted. Information has been collected and mapped in CASIPEDIA and regarded three sustainable innovation initiatives in three different EU countries: Italy, Austria, and Estonia. The application of the, CASI-F consisted of a five-step approach, which was supported by two to three rounds of interviews, taking place at multiple time points from 2014 to 2016. This longitudinal case approach is ideal to capture the richness and complexity of unfolding learning processes taking place within and among organizations (Yin 2013), and to ground theory development in actual case data (Eisenhardt 1989; Glaser and Strauss 2017). A total of 18 semi-structured interviews were conducted by the CASI project's partners with the contact person for each sustainable innovation initiative and their collaborators. A first

semi-structured interview was conducted between March and July 2014, focusing on the assessment of practices, outcomes, and players of each innovation. A second round of interviews was conducted between November 2015 and February 2016 via half-day meetings (one for each case) whose aim was to highlight the critical challenges related to the project, and identify a set of actions to overcome these challenges. A final round of interviews was carried out between February and May 2016 with the aim of developing an action roadmap with the innovators. In order to increase information reliability through triangulation (Miles and Huberman 1994), we also collected secondary data from financial reports, institutional websites, press releases, minutes of meetings, process documentation, industry reports, and trade journals.

The research process followed a sequential path; however, results from each step were adjusted and further developed in the light of additional sets of data that made us reconsider and revise our first interpretations in order to improve the fit between the tentative framework and the information actually available (Lee 1999). Data were finally analyzed through a multiple-case study method aimed at tracing out a common trajectory to the action of innovators (Yin 2013). This choice also mitigates the limitations of single-case study analysis which provides little basis for scientific generalization (Stake 2013; Yin 2013), in particular, although the research results cannot be considered statistically robust, they give a not unequivocal vision of the phenomenon and enrich the theory being explored.

The selected case studies are Fondazione Banco Alimentare in Italy (FBA), the Estonian Food Bank in Estonia (EFB), and Wiener Tafel in Austria (WT). These are described below.

Fondazione Banco Alimentare[1]

Following the example of Fundació Banc dels Aliments in Barcelona, Fondazione Banco Alimentare Onlus (FBA—the name translates to Food Bank Foundation) was founded in Italy in 1989. Since then, FBA has been collecting the production surplus of the food supply chain, and through its network of 21 local food banks, has redistributed it to over 8898 charitable organizations that assist the poor and the needy all over Italy. In addition to its main collection programme from the food industry, in 2003 FBA launched a programme called "Siticibo", which aims to recover and distribute fresh and cooked food products discarded by hotels, hospitals, and schools.

Estonian Food Bank[2]

The Estonian Food Bank (EFB) is a non-governmental organization collecting food from producers/distributors and handing it out to people in need. EFB helps, first and foremost, families in difficult economic circumstances, the unemployed, and families with many and/or small children. Donors provide food free of charge, but people, organizations, and charities can also donate money. EFB operates with the

[1]CASIPEDIA listing: http://www.futuresdiamond.com/casi2020/casipedia/cases/1148

[2]CASIPEDIA listing: http://www.futuresdiamond.com/casi2020/casipedia/cases/1018

help of a network of local charities and organizations who are in direct contact with the families who need the food most. The work of the food bank relies greatly on the generosity of volunteers, who are active in the warehouse and at the office of the organization, and take care of the whole process of collecting, storing, packing, and distributing the food.

Wiener Tafel[3]

The initiative Wiener Tafel (WT) saves up to 3 tonnes of food per day from being thrown away in the area of Vienna, in Austria. WT supplies 18,000 people living in poverty through 104 social welfare facilities. The initiative receives valuable food donations from around 180 donors from the trade, industry, and agricultural sectors. More than 400 voluntary workers support WT by delivering the goods to shelters for impoverished women, mother–child residential homes, homeless care facilities, and refugee homes. In 1998, the concept for the initiative was developed by four students of the social academy that founded WT, as the first food bank in Austria, based on the model of a food bank in Hamburg, Germany. In 2001, WT had the opportunity to appear on TV, which enabled them to find sponsors for their first WT van. The first refrigerated car followed in 2005, and in 2006 their continuous expansion made it necessary to arrange further vehicles. WT is now considered a central actor of civil society in the area of Vienna.

7.5 The Business Model of the Food Banks

Through the assessment of the cases of WT, FBA, and EFB, we propose an adaptation of the three components of a social business model (Fig. 7.1), presented in the following subsections.

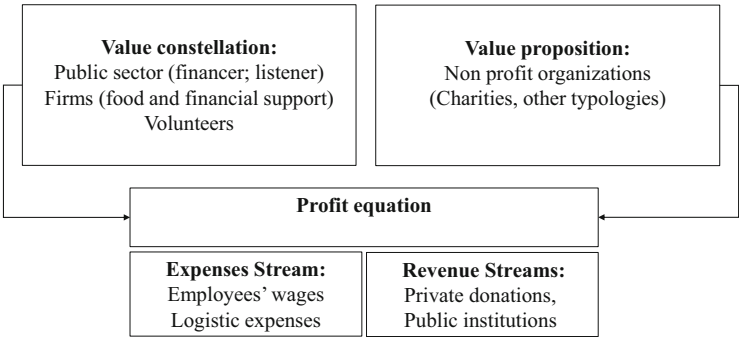

Fig. 7.1 Food banks' business model

[3]CASIPEDIA listing: http://www.futuresdiamond.com/casi2020/casipedia/cases/766

7.5.1 The Value Propositions of the Food Banks

The assessment of the food banks' value propositions highlights a convergence towards the same general goal, on the one hand, but with potential differences concerning the identification of the direct beneficiaries of the redistribution, on the other hand. When we asked the responders to explain the aims of their initiatives, their answers were very similar.

- According to the director of FBA: *"The mission of Fondazione Banco Alimentare Onlus consists in the daily recovery of surplus food from the food supply chain and its redistribution. Food Banks fight against food waste to feed the most deprived"*.
- Similarly, the responder for WT declared the goal of: *"Avoid[ing] that tons of groceries are thrown away [and] deliver[ing] groceries to people in need"*.
- In the case of the EFB, the aim is: *"Fighting the waste of food, sharing food with those in need"*.

Other indirect or related goals have been expressed by both WT, and EFB, as follows:

- *WT: "Build awareness regarding profusion. Protect the environment and mountains from waste. Provide a bigger amount of food and more healthy food supply through welfare facilities"*.
- *EFB: "Creating solidarity between human beings and responsibility for the weakest; fighting exclusion and poverty; and promoting healthier lifestyles"*.

Within the same general aim of food redistribution, the target groups of beneficiaries may vary.

- In particular, EFB focuses on *"helping, first and foremost, families with small and/or many children, who are living below the subsistence level"*, directly or in cooperation with other non-profit organizations engaged in this specific sector.
- FBA's target is wider, involving an extensive range of non-profit organizations operating in the field of welfare and social services, not necessary focusing on basic needs. In this vain, the director of FBA explains that: *"The Food Bank Network serves and involves different charitable organizations, soup kitchens, foster homes, shelters for children, drug addicts, unmarried women, parish associations, religious communities, and other organizations"*. In particular, *"we provide food for different non-profit organizations such as foster care communities, social cooperatives that support disadvantaged people in job seeking, parishes, and so on. In this way, they can focus on their specific aims, without the concern for food procuration"*.

Together with other non-profit organizations, and the direct beneficiaries of recovered food, other categories of stakeholders can obtain significant benefits from the action of food banks, as described in Table 7.2. The main indirect benefits that civil society can obtain from these initiatives emerge from the assessment of the

Table 7.2 Food banks' indirect beneficiaries

Importance of:	FBA	WT	EFB
Civil society	Raising awareness concerning food consumption.	Raising awareness concerning food consumption.	The activities of EFB have successfully promoted civic action and volunteering. The social sector benefits from its actions.
European Union	The EU can rely on successful action on the problem of food waste in the definition of new policies.	EU is not a direct/indirect beneficiary.	EU is not a direct beneficiary; however, it can benefit indirectly, through improved regional development.
Non-profit organizations	Both co-producer and beneficiary of the initiative.	Both co-producer and beneficiary of the initiative.	Both co-producer and beneficiary of the initiative.
National and local government	FBA offers support to the policies of welfare and social inclusion of the state and local governments.	Indirectly, positive effect on welfare state expenses.	No specific benefits.
Business actors	Promotion of corporate social responsibility and reputation. Efficient management of surpluses and inventories.	Promotion of corporate social responsibility and reputation.	Promotion of corporate social responsibility and reputation.
Research and education actors	FBA results and data on food poverty can be used for research purposes.	WT volunteers promote initiatives to improve awareness of food recovery in schools.	Initiatives to improve awareness of food recovery in schools, and diffusion of a culture of solidarity across the country.

WT and EFB case studies. The case studies highlight the importance that these grassroots sustainable innovations have in raising both awareness concerning food consumption, and the attention to solidarity and collective responsibility.

The interviewee of EFB, in particular, explains that: "*The idea of helping the ones in need by giving them food has not been generally accepted by all Estonian government officials and representatives. Charity is sometimes seen as having demotivating effects on individual initiative and providing better work opportunities rather than direct help is preferred. The weakness of solidarity and collective responsibility have traditionally been deeply rooted in Estonian social life, but some changes are underway*".

With reference to the benefits for the EU and national and local government, two positive externalities are highlighted:

- The first one emerges from the assessment of FBA, and concerns the advantages that policymakers—both European and national—can obtain by involving the

operators in the design of policies, as well as in the process of determining the incentives available to support food recovery.
- The second benefit, highlighted by WT, is the relief that food banks are able to give to national welfare systems, in the context of the policies against poverty.

Finally, with reference to the benefits for business actors, two contrasting perspectives emerge: while WT and EFB limit the potential benefits to an overall improvement of business partners' reputations in the context of their corporate social responsibility practices, FBA identified a more direct benefit which concerns the management of firms' inventory. FBA's value proposition, in fact, relies heavily on the cost reduction advantages that both large retailers and food factors can obtain by entrusting the management of surplus to a food bank. As highlighted by FBA's interviewee: "*the recovery of surplus food underlines the economic value of food, and food donors can reduce storage and disposal fees while also putting products to good use instead of wasting them, thereby contributing to the common good of society*".

Finally, both FBA and EFB highlight some concerns with regard to the institutional context within which they operate. When we asked the responders to explain directly what the public sector can do in order to support their work, the role played by a favourable institutional context emerged as essential. With reference to Italian regulation, FBA representatives are strongly engaged in the process of removing potential normative boundaries: "*sometimes the external environment does not seem to incentivize food surplus donation, as food donors are wary of jeopardizing their brand image. They are not willing to take the risk of liability for the donated foods, and there are no fiscal incentives that promote food donation instead of other use*". Moreover, "*the rules for the Italian non-profit sector are often very complicated or difficult to apply*". In the case of EFB, together with stronger financial support, the requests made to the public sector concern the simplification of the regulatory framework: "*Estonian laws are seen as inflexible and not able to respond to the social needs of the population quickly enough. Some of the existing laws are considered to be absurd and prohibiting local initiatives. One of the examples is the Estonian food hygiene regulation policy, which has set very high standards even for institutions that wish to operate on voluntary basis (e.g. soup kitchens). Problems with food and tax laws have constrained the development of the organization*".

7.5.2 A Multi-actor Value Constellation

The assessment of the three food banks' value constellations highlights the ways in which the three models differ from each other with regard to scope, and the relationship with stakeholders, receivers, and, in particular, donors. Table 7.3 summarizes the main structural characteristics of FBA, WT, and EFB.

Table 7.3 Networks' structure and activities

	FBA	WT	EFB
Scope	National: Italy.	Local: Wien region (Austria).	National: Estonia.
Diffusion	Basically detailed, and continuous.	Basically capillary, and continuous.	Variable in terms of diffusion and continuity.
Main donors	Large retailers; food factories; meal cooking firms for fresh food.	Small commercial activities and farms in Vienna area.	Small commercial activities, private donors that provide both food and financial support.
Receivers	Formally certified non-profit organizations.	Local non-profit organizations.	NPOs/individual families/ associations of large families.
Network structure	FBA is the coordinator of local food banks. In charge of logistics.	Local food bank in contact with local NPOs. No national coordination.	Activities directly managed by the national food bank.
Volunteers/ employees	Both.	Volunteers.	Volunteers.
Financial support from public sector	Substantially absent or not perceived as significant.	Substantially absent or not perceived as significant.	Main source of income.

NPO: Non-profit Organization

In terms of scope, while WT is a local food bank, EFB and FBA both operate at national level. This implies that in the case of WT, the networks of both donors and beneficiaries are concentrated within the defined area of Vienna. In contrast, the networks of both FBA and EFB are geographically extended, including donors and beneficiaries diffused across each country. However, while FBA can rely on the work of local Italian food banks, with a diffused network able to grant stable food provision, EFB has to face the problem of potential discontinuities. With regard to the network of donors, FBA can rely on formalized partnership with the Italian food industry and large retailers. On the other hand, the receivers are non-profit organizations, which have previously been certified, so as to avoid inappropriate or opportunistic behaviours. With specific reference to FBA activities aimed at recovering fresh food (the "SITICIBO project"), the network is not diffused at national level, but concentrated within the major cities, and the receivers in this case are mainly local soup kitchens. In the cases of both WT and EFB, donors are, basically, small commercial activities and farms, and in the case of WT, are concentrated locally. Furthermore, for EFB's ordinary activities a central role is played by the donation of food and money by individuals. This is particularly significant when compared to the case of FBA: *"once a year, we organize the day of 'Colletta Alimentare'. On this day our volunteers, their families, and friends collect food from private donations, outside Italian supermarkets. We collect huge amounts of food, but these goods are just a drop in the ocean compared to those collected every*

Table 7.4 Stakeholders' roles in design and development

Importance of:	FBA	WT	EFB
Civil society	The involvement of volunteers is essential for the success of the initiative.	The involvement of volunteers is essential for the success of the initiative.	The involvement of volunteers is essential for the success of the initiative.
European Union	FBA participate to the EU discussion on food waste.	No role for EU.	Financial support.
Non-profit organizations	Leading organization is a non-profit. Non-profit organizations are the means to reach people in need.	Leading organization is a non-profit. Non-profit organizations are the means to reach people in need.	Leading organization is a non-profit. Non-profit organizations are the means to reach people in need.
National and local government	FBA collaborates with local and national policymakers to promote food recovery policies.	No role for national or local government.	Financial support.
Business actors	Business actors provide recovered foods to foster the network. Their contribution is irreplaceable. Financial support.	Business actors provide recovered foods to foster the network. Their contribution is irreplaceable. Financial support.	Business actors provide recovered foods to foster the network. Financial support.
Research and education actors	Universities and research centre: – Analyze and disseminate data on food poverty and FBA results; – Develop technological innovations to improve food recovery process.	No research and education actors are involved.	Universities and research centre analyze and disseminate data on food poverty.

day from the food industry and large retail. However this initiative is essential to increase the awareness from civil society of our activities".

Finally, with regards to the articulation of each initiative in their territories, two models can be identified: the first one is that of WT and EFB. In these cases, the lead organization (Wr. Tafel—Der Verein fur sozialen Transfer for WT, and Estonian Netherlands Charity Foundation for EFB) plays the role of a broker between donors and beneficiaries. In contrast, in the case of the Italian food bank, the lead organization—FBA—acts as coordinator of the local food banks who are responsible for reaching the beneficiaries; whereas food collection is coordinated at central level.

The success and development of the grassroots sustainable innovations advanced by the bottom-up initiatives of WT, FBA, and EFB strictly depends on the contribution of different actors, according to the models of collaborative innovations. Table 7.4 summarizes the operators' perception of the importance in the phases of design and development of different stakeholders.

The contribution of the stakeholders to the success of each grassroots sustainable innovation is often similar in each case study, with some significant distinctions. In particular, interviewees from FBA, WT, and EFB have convergent opinions about the importance of the actors that are directly involved in the typical food bank activities of food recovery and distribution. This concerns the perceived roles of the volunteers, who are the expression of civil society engagement, business actors, which are the providers of surplus food, and non-profit organizations, which are the means to reach people in need. In contrast, divergences emerge with respect to the role of public sector—EU institutions and local and national governments—and research and education institutions. For FBA, the roles of both EU and local governments are essential for the development of policies aimed at reducing food waste, and FBA is often considered a privileged informer in the process of policy-making.

An important result of the dialogue between FBA and policymakers at national level is the implementation of the Good Samaritan Law in Italy. FBA's president explained that: *"FBA was one of the promoters of this law, which, for the first time in Europe, stated that non-profit organizations providing free distribution to food-poor people are to be considered equal to the end-consumers for the purpose of maintaining, storing, and using foodstuffs"*. The role expected of public institutions by EFB focuses mainly of financial aspects. As declared by the interviewee of EFB: *"One of the main threats to the Estonian Food Bank has always been lack of money. If the Estonian government provided around 1/3 of the finances necessary for the stable operation of the organization, the risks would be significantly lower"*. Finally, WT demonstrates substantial independence from the public sector, declaring that neither the European Union nor national or local government are important for the success of the organization, which remains an independent initiative of civil society.

The benefits that the same stakeholder may obtain from the grassroots sustainable innovations are summarized in Table 7.2. Here a convergence among the initiatives can be observed again with reference to the non-profit organizations, which are considered both co-producer of the services, as described above, and main beneficiaries of the food banks' provisions.

7.5.3 Profit Equation: Between Voluntarism and Dependence from Public Sector

While the expenses of food banks are directly related to the structure of the offer (the higher expenses are those related to logistics and salaries), and are similar among the cases assessed, incomes are strongly related to the overall institutional context that determines the weight of public financing and donations, and affects revenues from minor commercial activities (if any).

In the case of EFB the financial coverage is primary granted by public institutions, national government and the European Union in particular, whose intervention

can be further promoted. According to the interviewee, *"Money coming from projects and the European Union does not guarantee stable and continuous funding. Financial help from the Estonian government has been asked for and is anticipated. The goal set by the organizational leader. . .is to receive one-third of the funding from the public sector"*. Donations from the private sector, in the case of EFB, are considered to be low (with the exemption of Swedbank, one of the biggest sponsors of the initiative). The interviewers suggest that this limited access to private financing is due to a cultural context not particularly conducive to donations. In the case of WT, in contrast, the main source of incomes is private donations. The responder clarifies that *"No governmental actors were involved [because WT] is based on a private initiative of four students"*, in addition *"WT is purely based on [private] sponsoring. . .it is fully assigned to donations"*. Finally, FBA combines private donations with public sector income, provided by regional governments, but the composition of these sources has changed over time. In 2012, public support was 70% of total incomes, but this percentage has decreased progressively to 30% in 2017. In those 5 years, the reduction has been offset by private donations, which increased by 110% overall.

7.6 Fostering Sustainable Innovation: Different Approaches for Different Business Models

Food banks propose an innovative and sustainable model of governance for the food industry based on the concept of recovery and waste elimination, with advantages for the organizations engaged in the provision of basic service for indigents, which are often third sector organizations. The relationship between the public sector and non-profit organizations engaged in food recovery is, in general, *supplemental* (Najam 2000), because food banks are engaged in activities of food recovery that cannot be considered, properly and directly, to be public services, yet they contribute to the creation of public value (Moore 1995) through intrinsic and diffusion benefits (Fig. 7.2).

Intrinsic benefits are primarily related to the savings for both the non-profit organizations in the food bank's network, who obtain free foodstuff for their beneficiaries, and the companies that can obtain advantages by reducing storage and disposal expenses. With reference to the diffusion benefits, the innovation promoted by the food banks can help in re-designing the overall model of consumption, facilitating both waste reduction, with potential positive effects on environmental issues, and the redistribution process from those with excess food (firms) to those in need (non-profit organizations and, indirectly, individual recipients of food). Furthermore, these initiatives allow a diffusion of awareness on the topic of food recovery and its social and environmental impacts within civil society and, conversely, can facilitate a bottom-up communication from citizens to policymakers,

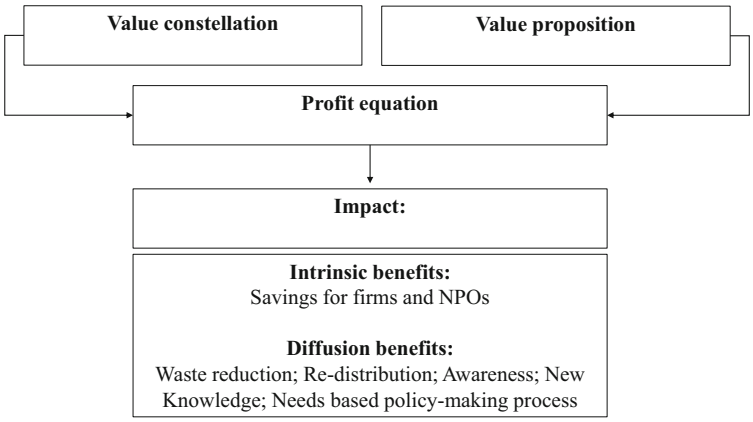

Fig. 7.2 Intrinsic and diffusion benefits of food banks' business model

such as in the case of Italy's Good Samaritan Law. In the case of the SITICIBO project promoted by FBA, the innovation related to the process for the transportation of fresh food across Italian cities, and this also contributes to the diffusion of innovative approaches to the conservation of fresh food, with potential benefits for the overall food industry.

Given the ability of food banks to generate both intrinsic and diffusion benefits, the challenge is to spread this recovery and redistribution model so as to make it mainstream in the food industry. The observation of three food banks across Europe through CASI-F highlighted that the path of diffusion of food recovery initiatives is not uniform; rather it requires adaptation to the social and institutional context, as well as to the specific features of the third sector organizations actually involved, whose business models can vary significantly. Together with the traditional model of non-profit organizations, we identified a second approach that we defined "entrepreneurial".

Traditional Non-profit Approach

According to the traditional non-profit approach to food recovery, firms are considered as partners that voluntarily contribute to food collection according to a philanthropic attitude. In this model, the non-profit organization focuses on their core activity, through the development of long-term collaboration with a selected number of partners (other non-profits and commercial firms) operating within a geographically limited region. In this context, innovation occurs in processes, in particular, and is aimed at increasing efficiency and effectiveness of the redistribution process.

In the traditional non-profit approach to food recovery, the role of the public sector can be less or more crucial, depending on the institutional and social context. When the relationship with the public sector is strong, a *charity-based* model (Furneaux and Ryan 2014) emerges, since non-profit organizations' financial

sustainability depends essentially on public grants. The relationship between non-profit organization and government is characterized by a weak cooperation with regard to objectives and planning, but there is a strong functional interdependence between the two sectors and consequently each supports the other. National and local governments depend on the food bank for the provision of a service for the reduction of poverty, and the non-profit organization depends on the public sector to finance its activities. This sort of relationship is typical in welfare partnership models (Salamon and Anheier 1998) in which third sector organizations are involved in the provision of welfare services, and funding is characterized by a large share of government revenue, rather than private resources. In this case, the public sector plays the role of *financer*, becoming functionally essential to the food bank's operations.

In contrast, when the relationship with the public sector is weak, a *complementary* relationship occurs (Najam 2000): the non-profit organization is independent from public sector funding; rather its financial sustainability depends on the contribution of private donors and volunteers. The food bank network is mainly managed by volunteers working on a local basis, and it assumes the characteristics of the typical grassroots sustainable innovation in which innovative networks of activists and organizations *"lead bottom-up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved"* (Seyfang and Smith 2007, p. 585). In contrast to the greening of mainstream businesses, grassroots initiatives operate in arenas of civil society, involving activists who experiment with social innovations. Given these characteristics, the growth of local networks tends to follow the trajectory of replications, which may be reactive, involving projects being established by activists without needing any instigation from niche-level actors, or proactive, through the support of intermediaries, actively working to seed and establish new projects (Seyfang and Longhurst 2016). Here the public sector can play the role of *facilitator,* initially focusing on internal networking, then directing efforts towards systematic shared learning. In this vain, a supportive regulatory environment is of crucial importance. A legal framework that facilitates food recovery becomes, in fact, a precondition for the replication of similar initiatives in other parts of the country.

Entrepreneurial Approach

When the approach to food recovery is entrepreneurial, firms are considered as strategic partners who can obtain cost reductions from the collaboration with the food bank. In this case, firms and food banks can create innovative solutions for the management of an integrated value chain able to support the overall process of food recovery. At the same time, food industry firms can manage the partnership with the food bank as a corporate social responsibility practice, with potential positive returns in terms of organizational reputation. The entrepreneurial approach implies a professional management of resources through the strategic involvement of different actors leveraging the relationships with stakeholder groups to initiate creative mechanisms that overcome barriers to accessing resources in the external environment.

The entrepreneurial approach, in fact, also implies the implementation of an innovative relationship between food banks and the public sector that becomes *collaborative,* with a commitment at the levels of both financial support and policy-making. In particular, a food bank that is largely independent of the public sector from an operational point of view, with progressively reducing financial support, may still be actively involved in the process of policy-making, through the implementation of bottom-up solutions suggested by the civil society. In this context, the public sector can play the primary role of *listener* and *partner*. By capturing to the opinions of private actors actually involved in the implementation of food recovery, public institutions are able to develop effective policies aimed at reducing waste, as well as to implement an appropriate system of incentives which favours, from the supply side, the donations of food, and, from the demand side, the distribution of surplus food.

In this vein, food banks can be considered as social entrepreneurs that affect social change by introducing innovative business models able to address some of the most complex social problems in both developed and developing countries. This entails active involvement by a group of actors—firms, non-profit organizations, and public administration, in particular—willing to address a wide range of issues such as poverty and social inequality.

7.7 Conclusions

Food banks propose novel solutions aimed at addressing food waste. They offer an innovative and sustainable model of governance for the food industry based on the concept of recovery, with advantages for both the organizations engaged in the provision of food to in individuals in need, and private firms involved in food production and distribution. Focusing on three case studies of food banks across Europe, namely Fondazione Banco Alimentare (Italy), Wiener Tafel (Austria), and Estonian Food Bank (Estonia), the goal of this contribution was the identification, within the business model of each non-profit organization in charge of the management of the food bank, of the factors that support and favour the diffusion of such initiatives. Our results suggest that together with the traditional non-profit approach to food recovery, in which firms are partners with a philanthropic attitude, the role of volunteers is crucial in supporting operational activities, and the scope is local, a more entrepreneurial approach is also emerging. According to this emerging model, the food bank's operating model is characterized by social entrepreneurship, and is able to promote social change through the active involvement of firms, non-profit organizations, and public administration, which collectively become promoters and implementers of innovative and sustainable solutions for the food industry able to support the reduction of poverty.

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Chapter 8
Why Sustainable Social Innovations (Do Not) Diffuse? An Alternative View to Social Innovation Dynamics

Rick Hölsgens

Abstract Awareness that technological innovations may not suffice to combat modern-day sustainability challenges has led to a growth in social innovation research. The existing literature oftentimes addresses the question of diffusion of social innovations, but whereas the majority of authors are concerned with the question of "how?," this chapter asks "why?." A better understanding of the "why" question will contribute to a better comprehension of the dynamics of sustainable social innovations. Building on insights from practice theory and effective law and regulation, this chapter stipulates the importance of addressing both the innovator and the adopters when trying to grasp the dynamics of sustainable social innovation diffusion. By asking why, rather than how, sustainable social innovations diffuse, it becomes clear that both innovators and adopters need to be motivated to actively diffuse the social innovation and they need to have the capacity to do so.

8.1 Introduction

Awareness that technological innovations may not suffice to combat modern-day sustainability challenges, combined with high expectations regarding the potentials of social innovation, has led to a growth in social innovation research. The number of publications on social innovation has skyrocketed in the last decennium (see also Chap. 3). A substantial part of the literature has addressed the question of diffusion of social innovations.

Whereas the majority of the literature on scaling and diffusion of social innovation has been concerned with the question of "how?," this chapter asks "why?." Why do individuals take up a socially innovative sustainable practice? And why do so many of us not? Obviously, the answers to these questions are as diverse as the socially innovative practice they are referring to. The purpose of this chapter is to

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introduce the "why" question into the debates on the diffusion of social innovations. A better understanding of the "why" question will contribute to a better comprehension of the dynamics of sustainable social innovations.

According to Howaldt and Kopp (2012) "in the face of the depth and development of change in modern societies and the rising dysfunction in established practice, social innovations are gaining greater importance, also in terms of economic factors, over technical innovations. They are not only necessary, but also can contribute proactively with regard to anticipated developments, such as demographic developments or the effects of climate change (. . .)." This claim illustrates the growing expectations of, and hopes in, social innovation. When researching the topic of social innovation, it becomes clear that definitions are manifold and varied. Given the "hype" that has emerged around the concept, and the political interest it has generated, it may not be surprising that the concept has caught on in various branches (academic but also political and societal). As a result, manifold definitions exist, and, given the open character of the terms "social" as well as "innovation," it seems straightforward that different actors interpret and use the concept differently (see also Edward-Schachter and Wallace 2017). In order to study, and come to understand, the dynamics of social innovation diffusion, the openness of the concept can be problematic though (see also Chap. 3, in which the different roles of social innovation for sustainability have been addressed).

8.2 Defining Social Innovation[1]

In short, social innovation can be defined as a deliberate change of a social practice. As simple and straightforward as this definition may seem, it captures a number of crucial elements. Firstly, social innovation is about a change in (a) social practice or, in other words, a change of (a) certain habit(s) or routine(s). It is about doing a certain habitualized practice differently. A social innovation is therefore not a one-time occurrence; it is about a lasting change of practice. Secondly, this lasting change of practice does not need to be innovative in the sense of being completely new. The core is not that the social innovation has to be radically new, but that it is radically different, different from the established practice. Thirdly, this new practice does not need to be "social" in a normative way. Many social innovations, especially sustainable social innovations, will have a normative component to them, but the main issue is a change of practice. It does not, in principle, matter whether this change is good or bad. This is directly related to the fourth element of the definition, namely the deliberativeness of the change. Social innovations differentiate themselves from other forms of social change because they are deliberate. Someone has an interest in changing a certain practice and does so on purpose. Whether this interest is in line with the collective or normative good is, for the understanding of the dynamics of social innovation, irrelevant.

[1]For a more elaborated discussion on defining social innovation, see Chap. 3.

Three important issues are left unaddressed in this definition though: (1) the level of organization, (2) the required size or outreach, and (3) the roles of the actors.

1. Does a social innovation need to be organized? And if so, what is the role of socially innovative initiatives and networks?
   When talking about the diffusion of social innovations, the degree of organization of the initiative is crucial. A well-organized initiative, perhaps carried or supported by a wealthy and/or powerful organization, will have different resources at its disposal than when the initiative is coming from an individual without established network. The aspect of power and resources will be addressed below, but it is important to stress that for the current understanding of social innovation and its diffusion, there does *not need* to be a fully organized initiative behind the novel practice.

   This somewhat goes against the definitions used in the EU Seventh Framework Programme's projects such as SI-Drive,[2] Transit,[3] and CASI.[4] Even though their theoretical definitions may be close to mine, their case study selection only included socially innovative initiatives that are organized. As such, they overlook less organized commencements of novel social practices.
2. How many people need to change their practices?
   According to Franz et al. (2012), "what is the decisive characteristic of social innovation is the fact that people do things differently (...), alone or together. What changes with social innovation is social practice, the way people decide, act and behave, alone or together." These authors thus equate individual behavioral change with social innovation. A social innovation can be considered to have diffused successfully, if a relevant social group complies with the novel practice introduced by that social innovation. The size of this relevant social group can vary and also the extent to which the novel practice needs to be adopted within a certain target group may differ, but it exceeds the level of the individual.

   A particular challenge remains where to draw the line between a mere socially innovative initiative and a social innovation. Pel et al. (2017) call attention to this "puzzling co-existence of socially innovative initiatives and the SI [social innovation] they promote" and also in the aforementioned projects TRANSIT, SI-Drive, and CASI—the mapped initiatives are oftentimes equated with social innovations. As the organized initiatives, however, may not be considered as social innovation, but rather as promoters or carriers of social innovation that try to put forward a change of practice, this problem can be circumvented.
3. Who are the relevant actors?
   Social innovations are deliberative changes of practices. As such, it is clear that there is an active role of a certain individual or group that as innovators aim to

[2] See https://www.si-drive.eu/ (last accessed April 30, 2019).

[3] See http://www.transitsocialinnovation.eu/ (last accessed April 30, 2019).

[4] See http://www.futuresdiamond.com/casi2020/ (last accessed April 30, 2019). CASI, Public Participation in Developing a Common Framework for the Assessment and Management of Sustainable Innovation.

change social practices. At the same time, there is a much larger group of potential adopters, those who should change their practices for the social innovation to diffuse successfully. Additionally, there may be a third group of intermediaries who have an interest in diffusing the novel practice and can support the innovator (for instance financially). For certain social innovations, it is clear who is the initiator of the practice change, but for other cases (especially those for which there are no organized initiatives) identifying the innovator is more difficult. Likewise, the size and composition of the relevant adopter groups can vary and identification may be challenging.

Now that we have established a working definition of social innovation and have discussed some of its characteristics, it becomes possible to explore the dynamics of diffusion. It will be addressed in this chapter by firstly reviewing (a selection of) the existing literature on social innovation diffusion. Secondly, a practice theory-based approach will be laid out which underlines the necessity to put the adopters more in focus. Building, thirdly, on insights from effective law and regulation, the elements of willingness and capacity will be introduced. The importance of willingness and capacity will subsequently be worked out in more detail, forming the basis for a framework for the study of the question of "why" diffusing a social innovation. Lastly, the importance of legitimation will be addressed.

8.3 Literature Review

8.3.1 Social Innovation Diffusion

The literature on diffusion of social innovations is very diverse, dispersed, and rapidly growing. This section therefore does not pretend, nor intend, to provide a systematic or complete review of the literature on the diffusion of social innovation. Rather, it will highlight a few relevant issues.

The first is that, when reviewing existing literature on social innovation diffusion, it becomes clear that attention is given first and foremost to the innovator perspective. Antadze and McGowan (2017), Deiglmeier (2018), and Westley and Antadze (2010), for instance, stress the importance of leadership. Dhondt et al. (2017) and Howaldt et al. (2016), among others, put emphasis on missing resources as barrier to diffusion. Although these issues are of vital importance, they only address one side of the coin.

The dynamics of changing practices within social innovation are still in need of further inquiry (see also Howaldt 2018). The "process dynamics" of social innovation diffusion as described by Rehfeld et al. (2017) are very comprehensive and provide a useful base against which to understand the dynamics of social innovations. Rehfeld et al. (2017) distinguish "four basic mechanisms that determine whether social innovations develop momentum and grow in scale or whether they are taken up more widely." These include (1) gaining attention and recognition;

(2) organizational growth; (3) external replication and commissioning; and (4) institutionalization. Especially the aspect of "gaining attention and recognition" targets adopters and successful marketing can increase adopters' willingness to take up a social innovation and to change their practices. By and large, Rehfeld et al. (2017) also focus solely on the innovator's perspective though the primary concern is how can the innovator reach the potential adopters.

In a recent publication, Oeij et al. (2019) identify six paths—based on seven conditional variables—that can have the highest chance for successful diffusion of social innovation. Interestingly though, in their analysis, adoption is only an outcome variable. The perspective of the adopters is completely neglected. By focusing on successful social innovations, and taking adoption as an outcome variable only, a selection bias occurs. Why did the failed social innovations not diffuse? Was that solely because the initiatives did not follow one of the six paths, or could it also be because adopters opposed the initiative?

The literature on social innovation ecosystems takes into consideration a broader view toward the environment in which the social innovation needs to find it way (Domanski 2018; Pel et al. 2018). Nonetheless, by and large, ecosystem approaches tend to focus on the institutional setting (e.g., infrastructure, resources, etc.), thus mostly ignoring the adopter's perspective.

And whereas many studies on social innovation address societal needs as a driver or even key aspect of social innovation (e.g., Millard et al. 2017; Moulaert et al. 2017), the actual willingness and capacity of prospective adopters to change their practices are generally overlooked. Howaldt et al. (2015), as well as Hasselkuß (2018), focus on imitation as "method" of diffusion of social innovation. This is an interesting approach, which can explain part of the motivation of adopters, but it does not sufficiently incorporate the question of why. Why do adopters imitate certain novel practices? And, more importantly, why do they so often not imitate the new practice? Especially in cases where, from a normative perspective, the social innovation seems to contribute to the collective good (i.e., in sustainable social innovations).

This bias toward the innovator can be understood from a pragmatic point of view as finding and mapping initiatives and providing them with questionnaires is comparatively easier than studying the adopter's side. Nonetheless, it is noteworthy from at least two perspectives. Firstly, because various scholars in other branches of innovation research have already convincingly laid out the importance of incorporating the adopter perspective to understand the diffusion of innovations (e.g., Pinch and Bijker 1987; Wejnert 2002). Secondly, if social innovation is defined as a change of social practices, it is remarkable how little attention is actually given to these practices, especially knowing that there is an entire academic community studying precisely this. Occasional calls to link social innovation research with practice theory approaches can be heard (e.g., Hölsgens et al. 2018; Howaldt and Schwarz 2017a), but concrete efforts are scarce.

8.3.2 A Practice Theory Approach

Part of a general comprehension of social innovation is the "expectation, generation, diffusion and stabilization of alternative everyday practices, that can satisfy needs, e.g. for nutrition, habitation or mobility in a less polluting way" (Stiess 2013). How and why individuals adopt alternative practices—central to most definitions of social innovation—remains under-researched in social innovation scholarship. This limits our understanding of the dynamics of social innovation. It also provides a too linear view of innovation diffusion. The question of why the (prospective) adopters do not change their practices, i.e., do not adopt the social innovation, tends to be overlooked. Even a very short engagement with the field of practice theory provides a number of vital clues though.

As stated by Jaeger-Erben et al. (2017), the reason why strategies to encourage sustainable consumption to date have failed should be seen in the fact that "consumption-related decisions and actions are part of social practices, which are embedded in individual everyday life sequences and infrastructural framework conditions, and which function relatively well as routines and which are therefore hard to change."

The "interdependencies, connections and configurations that are central to the constitution, reproduction and transformation of social life" (Blue and Spurling 2017) need to be studied and understood in order to be able to get to know how practices can change, i.e., how social innovations can come about. An important challenge lies in the fact that practices tend to be driven by routines and automatisms and therefore are less based on rationality (Reckwitz 2016). According to Blättel-Mink and Menez (2015), societal change therefore occurs not through rational choice, but through selection processes of variations in routines. This view, however, only allows for gradual change. Social innovations require conscious change. Existing theories on social innovation appear to assume too much rational acting. However, by studying the contextual elements of materials, competences, and meanings (after Shove et al. 2012; Shove and Walker 2010) and how they shape human acting, windows of opportunities for practice change may be identified. The absence of such windows of opportunity for deliberate changes of social practice offers key insights into the "why" of the often lacking, or sluggish, diffusion of social innovations.

Schäfer (2013) speaks of the elements of *corporeality* ("*körperlicheit*" in the German original), *materiality*, and *power and norms*. Although his characterization differs slightly from that by Shove et al. (2012), one can conclude that practices are determined by the human actor (and their physical and mental capabilities), the material (non-human) world within which the practice takes shape, and the norms and meanings attached to objects and acting/behavior. As acknowledged more recently also by social innovation researchers, "the study of the constituting elements and mechanisms of reproduction and reconfiguration of social practice enables a better understanding of social transformative processes (. . .)" (Howaldt et al. 2019). Sensitivity to this context and to the motivations of the adopters is crucial to

understand not only how but also why sustainable social innovations diffuse (or do not).

8.3.3 *Effective Law and Regulation*

Whereas social innovation research tends to focus above all on the innovator perspective, and practice theory approaches highlight how practices are shaped and stabilized, the study of effective law and regulation provides a—at first sight perhaps somewhat unexpected—middle ground.

In essence, the introduction of a new law or regulation can be seen as a regulator aiming to alter the practices of the "regulatee." Regulation refers to the interconnected activities of rule setting, implementation, and enforcement (e.g., Black and Baldwin 2010; Levi-Faur 2010; Scott 2010). Enforcement, however, is only possible in the case of hard regulation; for soft rules this is usually not possible. Following Reichow (2015), effective regulation is the degree to which policy goals have been achieved through the rule-compliant behavior of the regulated parties. Building on literature in the sociology of law, she states that rule compliance depends on the willingness (or motivation) and the capacity of regulated parties to follow rules.

The importance of rule-following behavior for the effectiveness of regulation is particularly significant in the context of soft regulation, since the regulatees follow rules voluntarily. Soft regulation refers to rules, for example, codes of conduct or guidelines that do not have legally binding force. Hence, soft regulation is not backed by legal sanctions and rule-following behavior is often incentivized. Researchers in this field of study therefore state that the willingness and capacity to apply a regulation from the side of those who have to comply with a regulation determine the effectiveness of a regulation (Reichow 2015).

Especially in cases where the regulation cannot be enforced, the willingness and capacity of the adopters to actually change their practices determine the diffusion of the new practice. In other words, we see that it is not the capacity of the innovator but the motivations and the capacities of the adopters that are decisive factors. The adopters need to be willing to change their practices and they need to be motivated to put an effort in changing their practices accordingly. However, besides willingness, they also need the capacity to change their practice. For instance, someone may be willing to follow regulations, stipulated in a code of conduct, but if they lack the capacity to adhere to the regulation because they do not have the necessary skills or resources, compliance can be expected to be low.

Whereas the literature on effective regulation focuses on the adopter willingness and capacity, the literature on social innovation makes clear that both sides of the coin need to be addressed in order to understand the dynamics of sustainable social innovation diffusion.

8.4 Why (Not) Diffusing Sustainable Social Innovations? A Framework of Willingness and Capacity

As the discussion of the literature has illuminated, in order to understand the dynamics of social innovation diffusion, we need to consider both the perspective of the innovator and that of the adopters. Furthermore, this chapter started with the assertion that it is important to not ask how the diffusion process works, but rather why the actors do, or do not, adopt and diffuse a social innovation. Building on the insights from effective law and regulation, willingness and capacity were identified as key criteria. The aspects of willingness and capacity of both the innovators and the adopters will be addressed below. Finally, the issue of legitimation, as a crucial part of the adopter willingness, will be given specific attention.

8.4.1 Innovator Willingness

The innovator needs to be willing to put an effort in the diffusion of the novel practice. This may sound trivial, but it is not. Howaldt et al. (2016) conclude, on the basis of over 1000 social innovation initiatives, that 90% of the initiatives were scaling up "in one way or another." At the same time, they observe that many initiatives do not manage to scale up. Based on their findings, lack of diffusion thus seems to be first and foremost an innovator capacity, rather than a willingness issue. However, willingness to diffuse is not always given.

Howaldt et al. (2016) find that almost all of the initiatives they collected intend to scale up, but we have to acknowledge two issues that somewhat undermine such a high number. Firstly, it is conceivable that the sample is biased toward initiatives driven by individuals or organizations with a—perhaps above average—motivation to diffuse the novel practice, as those innovators who lack the willingness to diffuse their innovation in the first place may never become visible to the researcher's eye. Secondly, the mere observation that initiatives indicate that they want to diffuse says little about the size of their ambitions. As acknowledged also by Howaldt and Schwarz (2017a), many initiatives do not have the ambition to be transformative (see also Haxeltine et al. 2017; Westley and Antadze 2010). This is not a problem as long as we acknowledge that social innovations can also be considered successful if they manage to change the practices of a smaller, but definable, relevant social group. However, it is important to be aware that the willingness to diffuse a social innovation is not always present.

The question emerges: why? Why do social innovators, in some cases, not care about the diffusion of their novel practice?

Like technological inventors/innovators, social inventors/innovators often start from the motivation to solve a local or personal problem; however, whereas favorable institutions providing incentives to technological inventors to diffuse their innovation are in place, these are lacking for social innovations. The patenting

system, for instance, allows inventors of technological artifacts to capitalize on their inventive efforts. For social innovators, the potential to gain wealth from their efforts is smaller, and in many cases altogether absent (cf. Dhondt et al. 2017). Social innovators therefore need a different driver.

Altruism or strong environmental concerns may be intrinsic motivations present within many social innovators and certain organizations may have sovereign tasks, which motivate their efforts. However, as social innovations do not need to be "social" in the normative sense of the word, less societally beneficial motivations may also be present.

The intrinsic motivations within some individuals are stronger or reach wider than those within others, and in cases where the intrinsic motivation for diffusion is smaller, external incentives (such as the possibility of commercialization) and supporting ecosystems are mostly absent. Many social innovators may be happy if they can solve their local or personal problem, but may lack the drive to diffuse the novel practice further. This, however, is hard to detect, as these social inventions never develop into initiatives that become visible to the wider audience.

The intrinsic motivations behind the innovator willingness to diffuse their social innovation thus deserve further study. Why do some innovators care more about diffusing their invention than others? Answering this question requires further research (and/or engagement with additional academic fields such as psychology). What seems beyond much doubt though is that an innovator with a high intrinsic willingness to diffuse the social innovation is a necessary prerequisite for the diffusion of sustainable social innovations.

8.4.2 Innovator Capacity

Willingness alone is not enough to be able to diffuse a social innovation; as mentioned above, many initiatives signal obstacles to diffusion (Howaldt et al. 2016). Oftentimes, the main cause will be sought outside or beyond the reach of the innovator, but in many cases one could, at least theoretically, probably maintain that if the innovator manages to build up more capacity (or manages to build a coalition with powerful moral entrepreneurs (Antadze and McGowan 2017) or relevant networks), also these barriers could be breached.

Westley and Antadze (2010) emphasize that social innovations require "a variety of actors, working in concert or separately." "Among these are the inventors, sometimes called social entrepreneurs: the individuals who initiate or create innovative programs, products, or processes and seek to build an initial organization (...). (...) among their key characteristics is the capacity to work in highly complex conditions (...). However, equally important to social innovations (...) are the institutional entrepreneurs: those individuals or networks of individuals who actively seek to change the broader social system through changing the political, economic, legal, or cultural institutions, in order that the social innovation can flourish (...). Occasionally, individuals have the skills of both the social and institutional

entrepreneurs, but generally it is wiser to think of actor nets or groups behind successful social innovation" (2010). More recently, Antadze and McGowan (2017) picked up the concept of the moral entrepreneur who explicitly influences the landscape and can contribute to changing recognized principles or accepted rules and standards to the benefit of a (social) innovation. Given the many different skills and capacities needed to diffuse a (social) innovation, it is worth stressing that what is oftentimes, as has in this chapter hitherto been, called "the innovator" is indeed often a group of individuals or an organization (see also Pel et al. 2017).

Deiglmeier (2018) engaged herself extensively with the question of barriers to the diffusion of social innovations. She observes that "three barriers repeatedly block social innovations from reaching their broadest impact: scarce funds for growth, the fragmented nature of the social innovation ecosystem, and deficiencies in leadership" (ibid.). The first two seem rather external issues, at first sight out of reach for the innovator; however, according to Deiglmeier "The funding landscape and fragmented ecosystem require highly adept people to shepherd social innovations through the long journey to widespread social impact." Furthermore, she suggests that "attracting and retaining highly skilled people to navigate these complexities is a challenge (. . .)," thus underlining the importance of high capacity from the side of the innovator.

But what kind of capacity is needed? And how does this influence the successful diffusion of the social innovation? Literature on the types of capacity needed for innovators is surprisingly scarce. Collecting from separate publications and crossing academic fields, a first attempt at listing the relevant capacities can be undertaken.

The first type of capacity we can identify is power. Expectations regarding the empowering characteristics of social innovations are high (e.g., BEPA 2011). However, it needs to be recognized that this is not a given and innovators with more power can be expected to be more efficient in influencing the debate. Power is relative, and actors' relevant power can increase or decrease during the process (cf. Aibar and Bijker 1997). The women's right movement in the Netherlands around 1900, for instance, built up power through alliances (including with powerful men) (Hölsgens 2017). Power is a capacity that can grow, but it should not be taken for granted that social innovations lead to empowerment of (disadvantaged) actors (cf. Avelino et al. 2019); rather, it can be observed that power is an important resource in order to exert change and more powerful actors or actor coalitions can be expected to be more effective in diffusing their innovative practice.

Being well connected is a second, and related, valuable resource for social innovators. Connections enhance access to further relevant capacities and can increase the visibility and legitimacy of the initiative. Being part of an established network can increase the capacity of innovators, for instance through knowledge sharing (cf. Haxeltine et al. 2017; Pulford 2018). It can also enhance the power of the initiative; a single slow food initiative may not have very far-reaching impacts, but united in the Slow Food International Association, they may cherish transformative ambitions (cf. Dumitru et al. 2016).

As touched upon above, socially innovative initiatives require people with high skills to navigate the complex landscape within which they operate. These skills are

highly intertwined with possession of relevant knowledge and constitute a third type of capacity. As shown by the different roles of the social, institutional, and moral entrepreneurs (Antadze and McGowan 2017; Westley and Antadze 2010), various roles require various skills and knowledge to successfully diffuse an innovation. Skills and knowledge can—at least to some degree—be obtained through learning, which is vital for continuous capacity building.

A fourth type of relevant capacity is access to (financial) resources, or the ability to gain access. Resources are needed to develop the initiative, acquire additional skills, increase visibility, etc. For small-scale initiatives, resource constraints can be an important barrier (cf. Dhondt et al. 2017).

Fifth, social innovations, especially those with more radical (or transformative) sustainability ambitions, often lack an "institutional home" (cf. Haxeltine et al. 2017). As a result, they may land in a void, in between established sectors or domains. Social innovators therefore require the ability to bridge domains and to create legitimacy for their innovation. High capabilities at the side of the innovator to build bridges—not only in the form of strategic alliances, but also by crossing sectors and transcending institutional logics—are thus a vital innovator capacity (see also Haxeltine et al. 2017).

An innovator with high capacity may be able to influence the willingness and capacity of adopters. However, although the capacity of the innovator is a crucial ingredient for diffusion, its reach should also not be overstated. Many social innovations emerge as grassroots innovations, and it can thus be assumed that, at least initially, the innovator capacity is comparatively low. Hölsgens (2017), for instance, has shown how the innovator can build up capacity, but the diffusion of women's suffrage covered a period of more than three-and-a-half decades; thus besides capacity, diffusion also requires an immense intrinsic motivation from the innovator to keep pushing for a social innovation for such a long period of time.

Nonetheless, social innovations, like soft regulations, can be introduced by a more or less powerful and resourceful organization or individual, but they cannot be enforced. As such, they will always depend on adopter willingness and capacity.

8.4.3 Adopter Willingness

As with technological innovations and (soft) regulations, social innovators can try to influence the diffusion of an innovation, but the effectiveness of the social innovation crucially depends on the willingness and capacity of its adopters to actually change their practice. Before adopters' willingness and capacity can be discussed, the entity of "adopters" requires further scrutiny.

Sustainable social innovations can target many different social groups. Some innovations may target society at large, some specifically target certain subgroups such as low-income households or children, others may have a very specific geographical focus, and yet others may principally target society at large, but will only

attract sympathizers who share certain values or skills (e.g., ecovillages or fablabs). Predetermining who are the relevant adopters is therefore not straightforward.

The target group set by the innovator principally represents relevant adopters for the analysis of the diffusion of sustainable social innovations. However, the size of the target group may vary, and even if the target group is initially large, but only a certain subgroup indeed adopts the novel practice, this does not directly mean the social innovation should be considered unsuccessful.

The challenge of determining the desired diffusion (scale) of a social innovation is also addressed by Deiglmeier (2018). She quotes the Duke University's Center for Advancement of Social Entrepreneurship definition of the scaling process, which claims that "Social innovations have scaled when their impact grows to match the level of need" (ibid.). This definition, however, is not satisfactory for two reasons. Firstly, the level of need is vague: who determines the need and how is it measured? And can a social innovation not be considered a success, even if it does not match all needs? The second reason is precisely because of its focus on needs, which implies a normative approach. Innovations can spread even if there is no initial need. I therefore align with Deiglmeier (2018), who did not set a precise definition of scale because she "understood that scaling impact can look different for different innovations."

Predetermining the relevant social groups as adopters can be challenging. The same goes for studying their willingness and capacity, especially because even if a target group can be identified, it is likely to be rather heterogeneous. From studies in (environmental) psychology, we know that "although generally individuals will endorse all four values to some extent, there may be substantial difference in the extent to which different individuals endorse specific values" (Steg et al. 2014). The four values referred to are hedonic, egoistic, altruistic, and biospheric and can be clustered as self-enhancement values (hedonic and egoistic) and self-transcendence values (altruistic and biospheric). "Values reflect which overarching goals people find most important in life in general" (Steg et al. 2014). As such, they are considered "stable dispositions, which structure and guide specific beliefs, norms and attitudes that in turn affect behaviour" (Steg et al. 2014). Some people are mainly driven by self-enhancement values, while others are driven more by self-transcendence values. It can be assumed that in some cases individuals with shared values will find themselves united as relevant adopter groups (inhabitants of ecovillages can be expected to share self-transcendence values), but in general values will differ and so will also the willingness to adopt the social innovation.

Awareness about, and sensitivity to, diverging values contributes to our understanding of why adopter are, or are not, willing to adopt novel practices. Understanding of diverging value is central to the legitimation (and therefore diffusion) of sustainable social innovations; the issue of legitimation is addressed more extensively below.

8.4.4 Adopter Capacity

In order for individuals to be able to adopt novel practices, they need not only willingness but also the capacity to do so. The issue of adopter's capacity has recently come to the attention of social innovation scholars, especially with reference to the capability approach (Howaldt and Schwarz 2017b; Ziegler 2018). The capability approach holds that individuals have different capacities and calls on ethical grounds for taking these differences into consideration. Without wanting to ignore the importance of such ethical considerations, the primary goal here is to understand the mechanisms of social innovation diffusion. In order to understand why social innovations do or do not diffuse, it is necessary to be aware of the adopters' capacity and to study the extent to which sustainable social innovations match their capacities.

As social innovations, by definition, involve a change of practice, adopters need the ability to change their practices. From the side of the adopter, two kinds of capacity are of primary importance. The first is knowledge and skills and the second (financial) resources.

In many cases, adoption of a novel practice may not require a lot of knowledge or skills (although awareness is needed, which can increase with knowledge). Other social innovations may require substantial skills, for instance because they build upon, or make use of, (digital) technology, e.g., maker communities, hackerspaces, or ecovillages. Potential adopters that lack the necessary skills and knowledge will not be able to change their practice in accordance with the social innovation. Obviously, skills and knowledge can be gained over time, but when they are absent, and the intrinsic motivation to acquire them is also low, successful diffusion may not be expected.

The second kind of capacity required from the side of the adopters involves resources. Novel practices tend to involve a certain kind of investment, especially if these new practices move toward enhanced sustainability. The adoption of the deposit system on plastic bottles requires people to store the bottle once it is empty (if emptied while not at home it also requires carrying the empty packaging) and carrying it back to the store to receive back the deposit. This kind of initiative requires the investment of resources, i.e., time and (carrying) effort, which the adopters first need to be willing to invest (in this case the deposit money creates an incentive) and second need to have available. Using this example, the investment may seem trivial, but consider the time and effort invested by individuals who decide to move to an ecovillage and have to dig their own wells or grow their own food. Likewise, the adoption of sustainable social innovations may cost monetary and non-monetary resources. Whether or not the adopters will actually invest these resources depends on their willingness and motivation, but regardless of the willingness, the capacity needs to be there.

The aspects of adopter's willingness and capacity are crucial. Studies of diffusion of social innovations need to address these aspects more prominently than they have hitherto done. Here the need to draw from insights from practice theory becomes

most apparent. As mentioned above, practices are shaped by material and non-material contexts in which they occur. This context shapes the willingness, but especially the capacity, of adopters to change their practices. In order to understand why social innovations do or do not diffuse, this context is paramount.

Why, for instance, is car sharing relatively successful, yet more people do not adopt it as their new mobility practice? In order to answer this question, engagement with the motivations and capacities of actors is necessary. Some people, for instance, cannot afford to own a car, which can make them willing to share. Others may have strong environmental values and therefore choose not to own a car, but instead occasionally borrow one, if needed. For those who do not use car sharing, other motivations may exist. For many, a car is, for instance, seen as an extension of the personal space, which they do not want to share. Others may live in remote villages where car sharing infrastructures are lacking, or they may have to transport small children for which they need fixed children's seats.

As can be seen from this example, it is impossible to provide an exact answer to the question of why social innovations diffuse. In order to understand why social innovations do, or do not, diffuse, it is vital to consider the willingness and capacity of both the innovator and the adopters. One issue in particular deserves further analysis as it builds an important link between the innovator and the adopter perspective: legitimation.

8.5 Legitimation

(Perceived) legitimacy is a crucial motivator for rule-following behavior (e.g., Tyler 2006). In the literature on social innovation, legitimation appears to be under-researched though, which is remarkable, given the emphasis on legitimation in the much-cited article by Cajaiba-Santana (2014). According to the author "It is legitimacy that will give validity to actions that change social systems and create new and legitimised social practices; without legitimacy, 'it is difficult to attract others to participate' (Garud and Rappa 1994). Legitimacy gives actors the idea that new practices are worth being imitated and institutionalized (. . .), hence social innovation proposes new social practices through legitimised and purposeful actions." However, whereas Cajaiba-Santana (2014) stresses the importance of legitimacy, he does not elaborate on what it means for the diffusion of new social practices. Similarly, also Haxeltine et al. (2017) and Moore and Westley (2011) refer to the need for legitimacy, without developing the concept much further.

Becoming successful depends on the degree to which the (target) audience adopts it. Innovations therefore need to match the needs or wishes of the market/public. They have to convince potential customers/users/adopters that they are worthy of being purchased/adopted. In other words, the innovation has to be considered legitimate (cf. Hekkert et al. 2007; Markard et al. 2016). Legitimacy—even for sustainable social innovations—is, however, not a given. Like power, legitimacy is relative and can change over time (Markard et al. 2016). As a consequence,

legitimacy can be gained (or lost) and innovators have to face a process of "legitimation."

Exact definitions of legitimation vary, but the core of the concept comes down to the act of finding/seeking/providing legitimacy. Following Kishna et al. (2017), legitimacy can be defined as "a generalized perception that a technology or organisation [or social innovation] is desirable, appropriate and socially accepted." However, this is still rather vague, for what does it mean that something is desirable, appropriate, and socially accepted? And, more importantly, what is needed to reach this state? Merriam-Webster online dictionary defines legitimacy as "the quality or state of being legitimate." Legitimate, subsequently, can have a number of definitions; the relevant one for the current context is: "conforming to recognized principles or accepted rules and standards (...)."

A product, service, or any type of socially innovative initiative is thus considered legitimate if it conforms to recognized principles or accepted rules and standards. Working our way backward, legitimacy is thus concerned with the quality or state of conforming to recognized principles or accepted rules and standards. If legitimation, then, is the process of finding, seeking, and providing a state of conformation with recognized principles or accepted rules and standards, we see that there are at least two entrance points for the legitimation process of sustainable social innovations. The first is to make sure to fit in with the existing structures. It may, for instance, be easier for renewable sources of energy to find acceptance if they provide the same service as the conventional energy source or if they link with other emerging renewable energy technologies and their discourses (Bergek et al. 2008). If switching to renewables means that the power supply becomes less stable because it is dependent on the availability of wind, this interferes with existing standards and practices and will make it more difficult to find acceptance. Similarly, social innovations that fit neatly with existing institutions and institutionalized practices will be more easily accepted (cf. Moore 2017). The second entrance point is the aim to change the recognized principles or accepted rules and standards (see also Haxeltine et al. 2017). This may, in general, be the more difficult route as it involves changes in complexes of practices, but it will most probably be required for more radical change. In this case, the social innovation needs to be able to create its own legitimacy by changing the accepted institutions and the process of finding legitimacy may have to be expanded well beyond the limits of the individual initiative.

(Perceived) legitimacy plays a central role in understanding why social innovations diffuse. With increased legitimacy, adopters' willingness to adopt the new practice may be increased. However, adopters' capacity (material as well as non-material, i.e., cognitive) will determine the extent to which the novel practice will actually diffuse. In other words, legitimacy is key to diffuse social innovations, but it can answer only a part of the question why social innovations do or do not diffuse.

8.6 Conclusions

Building on insights from practice theory and effective law and regulation, this chapter stipulated the importance of addressing both the innovator and the adopters when trying to grasp the dynamics of sustainable social innovation diffusion. Existing literature, to date, tends to focus foremost on innovator's capacity. By asking why, rather than how social innovations diffuse, it becomes clear that both the innovators and the adopters need to be motivated to actively diffuse the social innovation. Innovators need an intrinsic willingness to push the diffusion of their innovation. Given that a successful diffusion of a social innovation can take multiple decades, it is clear that this intrinsic motivation has to be strong. This may also help explain why some social innovations do not diffuse successfully. If innovators lack the motivation to diffuse their idea, diffusion will be hampered.

At the same time, adopters need to be willing to change their practices in accordance with the social innovation. (Social) innovations cannot be enforced and their adoption completely depends on the willingness of adopters. Some first insights on why adopters decide to change their practice can be found in the area of (environmental) psychology, but more research, especially from a sociological perspective, is needed to better understand the diffusion dynamics of sustainable social innovations.

An important part of the answer to the "why" question may be found in practice theory. Practice theory, although less strong in explaining more radical and deliberate changes of practices, helps to understand the stability of practices, as practices are habitualized routines that are shaped and consolidated by the context in which they take shape. This directly relates to the capacity of adopters to change their practices, another key element in understanding why social innovation diffuse, and especially why they often do not. If adopters lack the cognitive or physical capacity to change their practices, it cannot be expected that they will take up a sustainable social innovation.

Legitimation plays a vital role in the diffusion of social innovations. Adopters need to consider the novel practice "worthwhile" in order for them to become motivated to change their practices. Here innovator's capacity can also play a key role, as, through campaigning, the innovators can influence the perceived legitimacy of their innovation. In order to find legitimacy, innovators can try to make their innovation fit as closely as possible with existing structures, making it more recognizable and therefore more easily acceptable. However, for more radical innovations, this may be less feasible, as these, by definition, fall outside the established and accepted practices. In this case, creating legitimacy will be more challenging, and larger innovator capacity will be required. To understand why sustainable social innovations do, or do not, diffuse, it is vital to study the perceived legitimacy of the novel practice, and to ask whether both the innovator and the adopters have the willingness and the capacity to actively diffuse the social innovation.

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Chapter 9
An Inductive and Multidimensional Approach to Sustainable Innovation: Evidence from Multiple Case Studies

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Abstract Governments, businesses, researchers and civil society actors need to assess multiple critical issues (e.g. barriers, drivers, opportunities and threats) and put in place diverse management initiatives in order to effectively foster sustainable innovation (SI) processes and achieve multi-systemic transformations. As part of a large European Union-funded mobilisation and mutual learning (MML) effort to advance knowledge and develop a framework for the assessment and management of SI (CASI-F), a broad sample of critical issues have been identified through the mapping and analysis of over 500 sustainability-related initiatives, including product, service, social, organisational, governance, system and marketing innovations. An inductive analysis of these issues served to identify a set of 50 critical factors, which helped to develop a SI management framework structured around ten key aspects and four dimensions. Given the multidimensional and open nature of SI, the issues were also mapped, in parallel, from technological, economic, environmental, political, social, ethical and spatial perspectives. The study thus resulted in a number of practical considerations and lessons for SI management.

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9.1 Introduction

Sustainable innovation (SI) differs from other areas of innovation in that SI adopts a much wider system view and its activities typically address issues the solution to which demands observing the problem from multiple points of view. For this reason, SI also requires looking for insights from multiple stakeholders.

To understand and provide advice on how to manage sustainable innovation, SI analysts need to make assessments and propose actions from technological, social, economic, ethical, political, environmental and spatial (TEEPSES) perspectives (Popper et al. 2016).

In addition, the analysis of SI demands structured approaches that look for the profound motivations of the innovation process, whilst taking into consideration critical issues that influence the success and sustainability of innovations, which the innovators are likely to be confronted with during the lifetime of their innovations. In CASI, mapping practices, outcomes and players of multiple SI processes proved useful to identify these key aspects. The study described in this chapter demonstrates how a methodological strategy that combines and applies an inductive and multidimensional analysis to SI critical issues serves to generate practical recommendations for SI assessment and management. After this introduction, Sect. 9.2 offers an overview of the background for the analysis presented in the chapter. Then the inductive method to analyse critical issues and resulting SI management dimensions are discussed in detail in Sect. 9.3. This is followed by a description of the multidimensional method for the analysis of critical issues in Sect. 9.4. Finally, some 60 SI management recommendations and lessons are shared in Sect. 9.5, followed by some conclusions and final remarks in Sect. 9.6.

9.2 Background

The objectives of the 'state of the art of sustainable innovation' work package in the CASI project (Popper et al. 2016) were (1) to position sustainable innovation within the framework of the Horizon 2020 Societal Challenge on 'Climate Action, Environment, Resource Efficiency and Raw Materials' of the European Commission and (2) to set the foundations for the assessment and management of sustainable innovation. In order to better position the concept of SI, the CASI project developed a comprehensive methodology to review areas of research related to Climate Action, Environment, Resource Efficiency and Raw Materials, as well as to evaluate selected case studies of sustainable innovation initiatives mapped in CASIPEDIA.[1] Incorporated work and perspectives from environmental scholars (Carrillo-Hermosilla et al.

[1] A database of SI initiatives mapped during the CASI project. Experts and supporters of sustainability agendas can access the CASIPEDIA platform to learn from different initiatives. CASIPEDIA also facilitates the analysis of practices, outcomes and players of different types of SI.

2009, 2010; Charter and Clark 2007; Porter and van der Linde 1995; Fussler and James 1996; Rennings 2000; Andersen 2002; Geels 2002, 2005; OECD 2005, 2009; Kemp and Arundel 1998; Kemp and Pearson 2008; Oltra and Saint Jean 2009), European Commission environmental research programmes (FP5, FP6, FP7 and Horizon 2020) and multiple stakeholders mobilised in CASI (innovators, citizens, etc.) served as the basis for the project and was used to propose a working definition of sustainable innovation as '*any incremental or radical change in the social, service, product, governance, organisational, system and marketing landscape that leads to positive environmental, economic and social transformations without compromising the needs, welfare and wellbeing of current and future generations*' (Popper et al. 2016, see also Sects. 1.1–1.3).

To put the basis for assessing and managing sustainable innovation, we undertook a systematic set of mapping activities that included an inductive analysis of more than 500 cases and a multidimensional analysis of SI critical issues, in order to extract lessons for SI managers and to guide the conception, design and development of the methodological framework known as CASI-F (see Sect. 1.4; Popper et al. 2017). The nomination and mapping of the SI initiatives against practices, outcomes and players-related criteria generated a resourceful database[2] of critical issues related to SI initiatives from Europe and the world. (Most of these, at the time of writing, remain publicly available in an online platform called Ideas Bank).[3] Critical issues refer to technological, economic, environmental, political, social, ethical and spatial (TEEPSES) issues that have the potential to shape the present and/or future of a given sustainable innovation. These critical issues can be barriers, drivers, opportunities or threats. Over 1500 critical issues were identified with the support of key stakeholders—most importantly innovators, but also sponsors, supporters, beneficiaries and users who were given access to the online mapping and knowledge co-creation platform (CASIPEDIA) and invited to contribute to the evaluation of the SI cases.

9.3 Inductive Method to Analyse Critical Issues

Inductive methods are frequently utilised in research to devise ground theories that help explain complex societal problems. As pointed out in 'Inductive Reasoning and Bounded Rationality' (Arthur 1994), '*as humans we are only moderately good at deductive logic, and we make only moderate use of it. But we are superb at seeing or recognising or matching patterns—behaviours that confer obvious evolutionary benefits. In problems of complication then, we look for patterns; and we simplify the problem by using these to construct temporary internal models or hypotheses or schemata to work with*'. In this vein, we decided to take an inductive approach to the

[2]CASIPEDIA URL: http://www.futuresdiamond.com/casi2020/casipedia/

[3]Ideas Bank URL: http://www.futuresdiamond.com/casi2020/ideas-bank/

simplification of the problem of making sense of such a large number of critical issues, in order to arrive at a more manageable set of what we called 'critical factors'. The process included the following steps:

- SI practices were analysed to identify those factors that have the potential to increase or decrease the chances of success of the innovation processes. The outcome of this exercise was a preliminary list of critical factors.
- A content analysis software was then used to support and facilitate a preliminary clustering of the previously identified critical factors. This task also included word counting and critical analysis of terms.
- Finally, three focus groups of experts were held at the University of Manchester to discuss and agree on definitive clustering criteria. As a result, two levels of clustering were defined. The description and the name of the critical factors were also defined through these discussions.

9.3.1 Critical Factors, Key Aspects and Dimensions of Sustainable Innovation

The above-mentioned analytical process led to the identification of a set of 50 *critical factors* (Table 9.1) that were clustered into four management *dimensions of sustainable innovation* (SI context, people, resources and impact) and ten related *key aspects* (see also Fig. 1.9). The 'context' dimension includes key aspects of SI, such as momentum, foresight, resources and actors' mobilisation; the 'people' dimension covers the aptitude and attitude aspects of stakeholders; the 'process' dimension refers to SI catalysing and fostering aspects; and the 'impact' dimension includes the SI capacity of transformation and sustainability.

From a multi-stakeholder mobilisation and mutual learning (MML) perspective, what is worth highlighting from the process of analysing critical factors is that, on the one hand, several stakeholders associated with the mapped SI initiatives have learned how to identify and prioritise those critical issues affecting the sustainability of their innovation process. On the other hand, the meta-analysis of all these critical issues helped us recognise important patterns or 'critical factors' that we used to learn about managerial needs and shape the construction of a framework of SI management 'dimensions' and relevant 'key aspects'.

The following subsections provide short descriptions for each of the four SI management dimensions, together with examples showing how the 50 critical factors relate to the ten identified key aspects.

Table 9.1 Framing critical factors, key aspects and dimensions of sustainable innovation

Dimension	Key aspect	Critical factor
1. Context	1. Momentum	Political setting
		Exemplars
		Problems
	2. Foresight	Horizon scanning
		Strategic targets
		Trends
	3. Resources	Geographical setting
		Funding sources
		Infrastructure
		Data sources
		Scalability
	4. Mobilisation	Public participation
		Community support
		Institutional support
		Champions and facilitators
		Public–private partnerships
		Research and education engagement
2. People	5. Aptitude	Leadership
		Charisma
		Creativity
		Knowledge
	6. Attitude	Enthusiasm
		Empathy
		Involvement
		Commitment
3. Process	7. Catalysts	Comprehensibility
		Crowdsourcing
		Learning by doing
		Supportive services
		Absorptive capacity
		Ex ante impact evaluation
		Piloting and experimenting
	8. Fosterers	Incentives
		Coordination
		Networking and synergy
		Knowledge management
		Intellectual property management
		Ex post evaluation and monitoring
		Communication and dissemination
4. Impact	9. Transformations	Stakeholder and community development
		Knowledge-based products and services
		Values and lifestyle changes

(continued)

Table 9.1 (continued)

Dimension	Key aspect	Critical factor
		Multi-challenge approaches
		Capacities and skills
		Entrepreneurship
	10. Sustainability	Societal sustainability
		Economic sustainability
		Environmental sustainability
		Government system sustainability
		Infrastructure system sustainability

Source: Popper et al. (2016)

9.3.2 SI Management Dimension 1: Context

The success of SI depends heavily on the contextual circumstances surrounding the innovation process. To begin with, the 'momentum' key aspect should be understood as an eventual space for innovation where entrepreneurs' objectives, the political context (e.g. procurement and regulating aspects), other ecological and social initiatives and the perception of a common sustainability 'challenge' give rise to a positive environment for devising creative SI solutions. Secondly, the 'foresight' key aspect of SI brings the potential to anticipate, define strategies and to be prepared to foresee future innovation difficulties and opportunities. Thirdly, the key aspect of 'resources' combines varied factors, like people's skills, companies' capabilities, funding options, location advantages and market matching opportunities. Finally, the 'mobilisation' key aspect refers to the capacity for promoting public participation, getting communities' endorsement, achieving adequate support from institutions, getting promoters and social facilitators' commitment, establishing public–private partnerships and engaging with research and education actors.

9.3.3 SI Management Dimension 2: People

People's behaviour influences very significantly the effectiveness of SI processes. Such an influence can be observed both at individual and collective levels (e.g. business leaders, professionals, scientific communities or lobbying groups' initiatives). Policy goals would be unachieved if policies and programmes are not capable of engaging nor offering attractive incentives to the right people. 'The entrepreneur' or 'the innovation leader' roles deserve special attention in a knowledge-based society, as it demands a focus on multiple and complex necessities. In this context, it is essential that entrepreneurship or leadership skills are well distributed, balanced, shared and based on a spirit of teamwork. In contrast to other general types of innovation, the SI ecosystem normally shows positive conditions to

these skills, whilst admitting that the figure of the 'heroic' and 'solitary' innovator still remains.

9.3.4 SI Management Dimension 3: Process

Innovation is often recognised as a complex, participatory and multidimensional process. The analysis of SI initiatives mapped in CASIPEDIA confirmed the importance of paying careful attention to different points of view and multiple actors involved in SI projects. Assessing SI processes has to draw on the interpretation of many factors as well as on their eventual synergies. As we have too much options for clustering, and looking for simplicity, the critical factors were classified into two categories: 'catalysts' aspect, i.e. factors that support the activation and launching of the innovation, and 'fosterers' aspect, which involves those factors that facilitate the continuation and strengthening of SI measures.

9.3.5 SI Management Dimension 4: Impact

The impact of SI processes can be studied from two distinct angles. We could use a transformational (system transformation orientation) approach, the objectives of which, if achieved, would eventually give rise to a positive contribution to address broader sustainability challenges, e.g. lifestyle modifications, sustainable economic growth, community sense reinforcement, commitment with entrepreneurship, etc. Alternatively, impacts can also be the consequence of targeted actions that address SI challenges more precisely and specifically. With this assumption, the influence and impact of successful SI processes can be evaluated from social, economic and environmental perspectives. CASI-F confirmed that SI initiatives often bring about transformational impact, and, at the same time, SI challenges-oriented strategies.

9.4 Multidimensional Method for the Analysis of Critical Issues

This multidimensional analysis ran in parallel to the above-described inductive approach. The main objective was to analyse the critical issues (mapped in CASIPEDIA) from multiple perspectives, including technological, economic, environmental, political, social, ethical and spatial, all of which helped to elaborate a set of practical considerations for SI management. The critical issues identified included over 1500 barriers, opportunities, threats and drivers of innovation, and 644 factors

Table 9.2 Critical issues rated from multiple perspectives

Critical issues	Tec (%)	Eco (%)	Env (%)	Pol (%)	Soc (%)	Eth (%)	Spa (%)
Factors of success (644)	14	21	20	11	22	6	7
Barriers (382)	13	34	4	19	24	1	4
Drivers (406)	9	24	19	17	25	3	3
Opportunities (422)	10	24	25	9	26	1	5
Threats (290)	14	37	6	16	21	2	3

Note: Analysis of technological (Tec), economic (Eco), environmental (Env), political (Pol), social (Soc), ethical (Eth) and spatial (Spa) critical issues and factors of success from 202 cases in CASIPEDIA, see http://www.futuresdiamond.com/casi2020/casipedia/cases/

of success from 202 SI initiatives. A breakdown of these critical issues mapped against multiple perspectives is included in Table 9.2.

Each SI case mapped in CASIPEDIA included a list of SI *factors of success*, i.e. inputs, resources and other elements with potential to positively affect the SI process. Amongst 644 factors of success the most important were of social (22%), economic (21%) and environmental (20%) nature. The most important social factors refer to contexts where the awareness about sustainability challenges is relatively high, and the innovation is recognised as a solution that will eventually produce a highly positive impact on the environment. Most important economic aspects of success include the possibility for a SI to increase energy efficiency of industrial processes to promote energy savings, as well as the capacity of innovation to generate new job opportunities.

The *barriers* to SI are sometimes more difficult to identify, since public reports and companies web pages tend to showcase the success stories of their business, projects or initiatives. In the CASI project, although cases of 'failures' were outside of the project's scope, analysed initiatives show that (a) innovators find difficulties along and beyond the SI process; (b) sometimes SI processes have very short life, although long enough to learn about 'what sort of things could go wrong'; and (c) other SI cases that seem to have had a long life have actually failed to adequately develop themselves, thus remaining endlessly in the 'innovation' basket. 382 barriers were mapped in CASIPEDIA, most of which were economic (34%) including resource scarcity and high initial investment, followed by social barriers (24%) related to coordination of multiple actors and interest, the scepticism of users and governments due to lack of understanding, as well as overall resistance to change. Political barriers (19%) that were considered important by the CASI mappers included ineffective regulation, hard bureaucracy, institutional inertia and strong resistance to change.

The analysis of SI *drivers* looks at the context and SI motivations, in every phase of the SI process, i.e. from idea conceptualisation to design, development and dissemination. The most significant drivers amongst 406 mapped were social (25%) and economic drivers (24%). Social drivers referred to issues of welfare, social inclusion and human health, whilst economic drivers drew to the attention

economic benefits, cost reduction, self-employment and local development and employment matters.

Assessing SI *opportunities* is related to financial gains, cultural enrichment and technology advances. Amongst 422 opportunities mapped, rather equal importance was given to social (26%), environmental (25%) and economic (24%) ones. Social opportunities were found in the knowledge transfer mechanisms, public participation, enthusiasm and motivation, partners' awareness, as well as networks' support. Environmental opportunities were in large part related to waste up-cycling alternatives, whilst economic ones focused on market needs and gaps and financial stability and support.

SI *threats* are negative factors and risks (expected future risks or existing factors in the present), which could have impact on the positive outcome of the SI initiative. Alongside the innovation process threats could be experienced in the form of financial issues, social discontent, unexpected collateral effects, climate change or inadequate or unavailable infrastructures, to name only a few. Economic problems (37%) are by far the most significant and include lack of capacity to meet demand, constraints related to economies of scale, decisions to abandon research and innovation activity and the lack of adequate business model to face competition. As for social types of threats (21%), the clearest threats include an excessive dependency of volunteering recruitment and absence of appropriate social impact evaluation. The most prominent political threats (16%) are related to changes in government priorities and the collision of vested interests.

The analysis of critical issues shows that ethical considerations are surprisingly absent in SI. One possible explanation could be that ethical aspects are somehow intertwined with social ones; thus, they could be camouflaged under that category. Nonetheless, even though ethical concerns are unlikely to outweigh economic factors, it is important to consider ethics of sustainable innovations as SI frequently aspires to tackle complex societal challenges and environmental issues.

Following the previous analysis, a number of questions were discussed for each type of perspective:

1. How can innovators benefit from factors of success?
2. How can innovators deal with the identified SI barriers?
3. How can innovators grasp SI opportunities related to the innovation process?
4. How can innovation threats be waived by the innovator?
5. How can strengths and weaknesses be treated?
6. How can innovators understand the effect of drivers and use them to address the SI objectives?

These, combined with the above outlined approach, led to the identification of a total of 60 considerations or recommendations for SI management, which are presented in the next section.

9.5 SI Management Recommendations and Lessons

In this section, the considerations have been formulated as recommended actions that SI innovators need to put in place in order to tackle problems that are often encountered in their operations. Furthermore, a cross-cutting analysis of recommended actions against the dimensions identified through the inductive approach, i.e. context, people, process and impact, has also served to extract useful lessons for SI management (Popper et al. 2016):

From a Technological Perspective, SI Managers Should Consider the Implementation of the Following Actions

1. Analyse dependence on other technologies
2. Develop an IPR strategy
3. Elaborate technology development plans
4. Identify and assume protection and imitation costs
5. Make plans for digital and social media communication
6. Guarantee an easy use of innovation
7. Create maintenance and contingency plans
8. Reinforce technical capabilities and capacities for technological anticipation
9. Ensure an adequate level of novelty in both radical and incremental innovations
10. Develop supporting infrastructures
11. Comply with tech standards and get the right level of complexity

Further Lessons for SI Management from a Technological Perspective

(a) It is crucial that innovators elaborate long-term innovation plans. These plans can include technology roadmaps, to visualise the present and future relations and dependences with other technologies. Roadmaps would also facilitate technological maturing plans and support the definition of corporative IP plans. By including relevant staff and strategic stakeholders in the roadmap creation process, innovators would, in addition, have the opportunity to better understand and capture societal and technological trends and perspectives.

(b) Participation is important to enhance staff's skills and foster technical creativity. It also contributes to boost motivation of personnel. Involving consumers in the SI innovation process also helps to identify technological pitfalls, find eventual obstacles on the usability of technical solutions and devise more insightful product development (or product substitution) plans.

(c) IPR strategies should be updated on a regular basis. Planning technologies protection actually requires forward-thinking processes that put into question the whole innovation project and assesses the importance of disclosing innovative ideas. These plans may be as well used as a tool for communicating some

(strategically selected) features of the innovation to potential funders and end users.

(d) Technology planning also helps to guarantee the sustainability of the ongoing innovation processes. By estimating consumers' necessities or anticipating the availability of strategic equipment and infrastructures, the technology innovation process can be more precise and address more efficiently social and environmental objectives.

From an Economic Perspective, SI Managers Should Consider the Implementation of the Following Actions

12. Elaborate market expansion plans
13. Create realistic business strategies
14. Design capacity enlargement and production adjustment plans
15. Differentiate between mass production and differentiation strategies
16. Define economic benefits targets, where applicable
17. Define cost reduction objectives, where applicable
18. Elaborate a strategy for local development
19. Assess the possibilities and implications of self-employment
20. Make a clear estimate of initial investments
21. Evaluate the availability of resources needed for the future
22. Ensure the stability of funds during the SI process
23. Increase/maintain adequate efforts in R&I

Further Lessons for SI Management from an Economic Perspective

(a) SI projects have often unrealistic missions and objectives. SI objectives should consider, in this sense, the analysis of local or regional opportunities. SI should be compatible with local and regional plans. It would allow to get an accurate idea of local needs and thus facilitate economic growth and regional stability.

(b) Business plans are very frequently inspired by very strong and unrealistic innovators' optimism. As a consequence, innovation plans are often risky and unapproachable. Staff hiring, for example, may become a heavy burden if the personnel recruitment plan is very ambitious and unaffordable. Since motivation and voluntarism are very common aspects amongst SI innovators, it is also important, in this respect, that the SI manager will find the right balance between such a voluntarism and the necessary specialisation and professionalism.

(c) SI typically demands a constant flow of funding. Innovation processes can thus be better reshaped and the production capacities be resized on time. Conserving and reinforcing research capabilities would contribute to build a positive corporative image in front of external actors and potential investors and show our profound understanding and conception of innovation.

(d) The capacity of SI to achieve a positive impact, either socially and/or environmentally, largely depends on the innovator's abilities and specialised knowledge background. To achieve economic impact, it is necessary that innovators are

accompanied and supported by managers that provide skills to positively change or update business objectives, monitor and analyse costs and benefits and strategically modify production plans.

From an Environmental Perspective, SI Managers Should Consider the Implementation of the Following Actions

24. Understand the potential and implications of climate change adaptation and mitigation strategies
25. Identify those environmental elements where SI could make a better impact
26. Develop environmental ex ante impact measuring tools
27. Evaluate the potential of SI to solve energy problems
28. Define and communicate how the innovation is contributing to promoting sustainable lifestyles
29. Evaluate potential ecological collateral effects

Further Lessons for SI Management from an Environmental Perspective

(a) Sustainability challenges usually have social, economic or ethical implications. They are present, directly or indirectly, in every Horizon 2020 societal challenge. SI solutions need to be conceived and developed with processes that recognise those aspects that positively affect the environment as well as eventual and pernicious collateral effects. The potential of SI to address environmental concerns must therefore acknowledge unintended damages and how these damages may be avoided.

(b) Sustainable innovators usually present abilities and enough motivation to raise awareness on the benefits of sustainable lifestyle. However, our work with CASIPEDIA has showed that innovator's attitude is not sufficient. Innovator's aptitude and knowledge capital of firms/organisations are also crucial to create impactful environmental solutions.

(c) SI processes must be modified in accordance with the evolution of the environmental issue at hand. Monitoring and modifying SI management decisions on time can eliminate eventual differences between innovator's initial plans and actual environmental objectives as well as reduce negative (social or economic) consequences.

(d) The impact of environmental innovation is only observable and measurable in the long run. This makes SI critically dependent on civil actors' awareness and their solid commitment to environmental protection. Convincing people to have an environmentally impactful lifestyle is, however, an arduous educational endeavour that usually goes beyond innovators' main priorities.

From a Political Perspective, SI Managers Should Consider the Implementation of the Following Actions

30. Understand bureaucratic processes
31. Acknowledge/influence government's political position
32. Analyse policy agenda opportunities
33. Learn applicable regulation
34. Be regularly informed of current and potential regulation changes
35. Achieve sustainable political support
36. Get timely access to experts and policy advisors
37. Estimate and assess lobbies' and competitors' reactions

Further Lessons for SI Management from a Political Perspective

(a) Policies, regulation changes and institutional R&I agenda may offer interesting opportunities that need to be fully understood and leveraged by innovators. In this sense, approaching scientific lobbies and experts' networks could be a strategic decision for innovators. This may be complemented by reviewing foresight studies (or participating in foresight projects) that utilises future scenarios to create sound and practical advice for management (Velasco 2017) and by analysing other sorts of SI-related reports.

(b) Networking depends on the SI managers' capacity to be part of policy agenda setting workshops and participate in different stakeholders' groups. It is desirable that managers are able to interpret the messages behind policy discourses.

(c) SI processes need to be resilient to political changes. A strategic network of collaborators and informers is useful to develop such a resilience. Similarly to owning instruments of technological intelligence, innovators must also be aware of new government initiatives and decisions in order to adapt their innovation action to the evolvement of policies and regulations.

(d) SI strongly depends on the definition of R&I policies and sustainability priorities. The complexity of SI problems calls for the convergence of varied actors' interests, which share a common policy agenda. Taking distance from the official agenda could consequently put innovator's efforts (i.e. his/her dedicated resources) beyond those areas that could attract much more political interest. Interesting SI solutions could be eventually considered of little interest by policymakers and potential sponsors. Business plans related to those cases would need to look into more favourable markets and political settings.

From a Social Perspective, SI Managers Should Consider the Implementation of the Following Actions

38. Elaborate a SI communication plan
39. Establish realistic poverty-related targets, where applicable
40. Establish achievable social minorities-focused objectives, where applicable
41. Establish realistic health targets, where applicable
42. Establish realistic welfare and security targets, where applicable
43. Interact with social actors with impact-oriented plans
44. Devise instruments to measure the social impact of the innovation
45. Design/implement motivation techniques for personnel
46. Balance the use of volunteering and professional resources
47. Keep alive the interest of beneficiaries in the SI
48. Coordinate the action of the actors involved
49. Develop knowledge transfer mechanisms and platforms
50. Update and share objectives with partners
51. Establish linkages/relationships with civil society organisations

Further Lessons for SI Management from a Social Perspective

(a) SI demands the innovator's interaction with relevant and influential social actors. To enable such an interaction, effective communication plans shall be used to present and explain the SI objectives. Coherence and convergence is needed between these objectives and the social, economic and environmental impacts that the SI will eventually achieve. SI would benefit, in this respect, from actions that raise the interest and empathy of SI actors and users. By (ex ante) evaluating and communicating expected impacts to these agents, the innovator will increase public acceptance and people's commitment towards the project.

(b) As a consequence of the interaction needed between sustainable innovators and civil society, sustainable innovation is very often considered merely a social innovation process. To avoid that, SI mission has to be explained and discussed with the main actors engaged or participating in each phase of the innovation process. The values of personnel, for example, need to be understood by SI managers to find out if they are compatible with the main ethical drivers and social motivation of SI.

(c) SI processes require to take decisions that have social impact. These decisions may help to accelerate and consolidate the innovation project. An interesting step would be the active participation of innovators in expert platforms and knowledge networks.

(d) Sustainable innovators shall also analyse the unexpected social consequences of their SI actions. For example, it is important to put in place mechanisms and barriers to avoid SI solutions bringing about any social exclusion experiences, e.g. some innovations could be unavailable or unaffordable to some social minorities, the elderly or very particular vulnerable groups.

From an Ethical Perspective, SI Managers Should Consider the Implementation of the Following Actions

52. Make ex ante evaluation of the SI ethical consequences
53. Avoid SI bringing about the exclusion of specific user groups
54. Develop a communication plan based on unambiguous organisational sustainability objectives
55. Identify and integrate all affected community members
56. Communicate how the innovation is aligned with social values

Further Lessons for SI Management from an Ethical Perspective

(a) SI sometimes leads to ethical debates, especially when proposed solutions are radical or disruptive. This is explained by the strong relations that sustainability projects have with social innovation and the effects that an ethically responsible lifestyle has on both types of innovation. Discrepancies between individuals' conceptions of sustainability, not to mention the diverse factors affecting SI processes, can make it difficult to harmonise every actors' interests and preferences. To manage these differences, innovators have to fully understand the discrepancies, and inform and involve as much as possible every legitimately affected stakeholder in the innovation project.

(b) The analysis of the ethical consequences of SI is often subject to many types of interpretations and potential biases. Consequently, innovators need to analyse their proposed solutions, and the opinions generated around them, with a very critical perspective. In fact, sustainability 'activists' may publish and disseminate opinions that basically vary with their affinity to the project and their empathy towards the sponsors or managers of innovation. Our study confirmed that opinions of this sort could become more relevant factors for SI than other human capabilities, such as creativeness or personal leadership.

(c) To raise the interest of users and investors in our sustainable innovation, we need to eliminate or at least minimise any ethical controversies and doubts. Reinforcing consumers' reliance on solution should be an important SI manager's ambition during the full innovation process. An effective communication strategy, focused on clarity and transparency, can help develop practical and emotional linkages between stakeholders and the innovation we work on. Such a strategy must delimitate unambiguously the differences between the pursued not-for-profit sustainability objectives and other financial targets of the organisation.

(d) Paying attention to the ethical aspects of SI will, to some extent, contribute to fulfil the objectives of transformation more effectively. Ethics-driven decisions can, in addition, support the continuity and sustainability of managers' action. Disputes around ethical and social aspects can certainly undermine the sustainability benefits of the innovators' action and the reliability of the full project. The elaboration of impact evaluations is useful in this respect to assess and inform in advance about positive social or environmental expectations.

From a Spatial/Geographical Perspective, SI Managers Should Consider the Implementation of the Following Actions

57. Establish realistic demographic objectives, where applicable
58. Align innovation with rural/local traditions
59. Contemplate heritage preservation in the innovation conception
60. Distinguish between local SI experimentation results and their application to other environments

Further Lessons for SI Management from a Spatial/Geographical Perspective

(a) On many occasions, SI objectives directly address the protection or development of rural/local culture and the preservation of local traditions. It is particularly useful that regional authorities and affected communities will endorse and support the SI action in these cases. Alternatively, rural communities-oriented actions can be conceived and developed in order to join and indirectly complement other SI targets.

(b) The innovators' interest in conserving local traditions and their motivation to preserve rural environment are important aspects to consider in the analysis of SI factors. A particularly favourable factor for SI, when SI relates to rural and geographical aspects, is the innovator's capacity to understand the historical and cultural background. In this context, aligning the innovation with the values and concerns of the people, e.g. by devising solutions to manage or preserve the local heritage, is an important innovator's objective that, if achieved, would improve the recognition of rural community.

(c) Sustainable innovators should evaluate the capacity of their solutions to tackle sustainability problems in local and regional areas. This could be made by analysing actors' opinions and behaviours in front of the provided solution and by assessing the extent to which the SI has improved people's living conditions and preserved rural culture. Targeting efficiently this sort of demographic and cultural issues is actually a favourable component of a well-balanced and productive innovation management.

(d) Another key aspect to be considered by SI managers is the capacity to differentiate experimental tasks from the application of their solutions in the real world or in very specific environments. Many innovations, for example, prove to work successfully only in particular conditions, e.g. remote locations, islands, very particular groups of users or consumers, etc. Innovators have to recognise and acknowledge this contextual dependency and admit that, in general, SI solutions cannot be easily 'replicated' in any geographical or demographic circumstances.

9.6 Conclusions and Final Remarks

The CASI project devised an innovative approach to provide meaningful and practical insights for a range of sustainability stakeholders. In particular, the inductive analysis of how the SI critical issues actually match with the innovator's experience, and the 'translation' of results into a coherent frame linked to context, people, process and impact dimensions, demonstrated to be a powerful instrument for SI assessment and management.

In addition to the potential of multidimensional approaches, the results have shown that data from multiple and diverse sources can be analysed and cross-compared, even though findings could sometimes contradict established paradigms. The lessons derived from this analysis, which have been scrutinised from multiple perspectives, have useful implications and suggestions for SI policy formulation:

- *Policymakers should take measures to facilitate fluid dialogues between SI players, in particular to improve and ease the interaction between SI innovators.* These dialogues would accelerate knowledge and technology transfer between governments, industry, academia and civil society actors. In this respect, CASI is a good example of sharing best practices of sustainable innovation, which can help innovators better understand common critical issues of their innovation processes. In fact, these issues will certainly influence, to a larger or lesser extent, their SI management activities and future plans.
- *To fully understand the contextual circumstances of SI, instruments of strategic intelligence should be used to support policymakers.* Utilising future scenarios as a methodology for foresight would consolidate the levels of actors' participation in sustainability governance and provide collective and long-term advice. The representation of citizens, innovators and other actors in SI policies has been suggested in a policy report—CASI Sustainable Innovation Policy Advice (Popper and Velasco 2017).
- *Agenda setting processes on sustainability need to be enriched with the experience of SI entrepreneurs and innovators.* Policymakers should encourage the participation of SI managers in the policy formulation process so that they can inform about their actual aspirations and concerns. Acknowledging potential discrepancies with innovators' objectives would guide the policy action towards more accurate and democratic definition of innovation priorities.
- *When formulating innovation policies and programmes for sustainability, policymakers should reflect on the wide range of values that are intimately associated with and eventually affect the SI processes.* The importance of raising people's awareness on sustainability challenges and the communication efforts needed to highlight the impact associated with these problems makes SI a field of work very much linked to pure psychological or social processes. In this sense, it is necessary that the objectives of sustainability-oriented policies are compatible not only with the SI actors' objectives, but also with their understanding of environmental problems and their social or cultural preferences.

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Chapter 10
Towards a Hybrid Framework for Sustainable Innovation

Tiina Pajula and Rafael Popper

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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