INNOVATION FOR SUSTAINABILITY

Business Transformations Towards a Better World

EDITED BY

Nancy Bocken, Paavo Ritala, Laura Albareda and Robert Verburg

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Laura Albareda · Robert Verburg
Editors

Innovation for Sustainability

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Praise for *Innovation for Sustainability*

"This is an important book. Bringing to bear leading edge thinking in innovation on problems in sustainability is critically important, and the authors present a comprehensive approach that will become an invaluable resource to both scholars and practitioners."

—Rebecca Henderson, *John and Natty McArthur University Professor, Harvard University, USA*

"Innovation stands out as a key factor in the urgent and challenging pursuit of improving economic, social and environmental sustainability. A transition to a new business paradigm, where a broader set of values than the mere financial ones are fully taken into account, requires disruptive changes to the way we think and act. This book offers a comprehensive view of the challenges that need to be overcome in order to increase innovation for sustainability, as well as concrete implications for both researchers and practitioners."

—Mats Magnusson, *Professor, KTH Royal Institute of Technology, Sweden*

Contents

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Introduction: Innovation for Sustainability

Nancy Bocken, Paavo Ritala, Laura Albareda and Robert Verburg

Rationale and Aims—Why This Book, Why Now?

Grand challenges such as climate change, economic and social inequality, as well as resource scarcity are increasingly recognized across the policy, business and academic domains (Ferraro et al. 2015). Scientists have described that we have entered a new geological epoch, the Anthropocene, by which the impacts that human development

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have caused on Earth systems are putting our resilience at risk (Steffen et al. 2011). In this regard, nine "planetary boundaries" (Rockström et al. 2009) are highlighted: climate change, rate of biodiversity loss, interference with the nitrogen and phosphorus cycles, stratospheric ozone depletion, ocean acidification, global freshwater use, land use change, chemical pollution and atmospheric aerosol loading. This analysis has been integrated in international studies such as the latest Intergovernmental Report on Climate Change report (IPCC 2018a) that shows the pressing need to limit global warming.

Indeed, the most pressing issue of all is the climate change, because it is intertwined with several other sustainability issues. The IPCC (2018a) is clear on the ever more pressing need to tackle climate change to curb further devastating effects, including reduced crop yields, increasing sea levels, coral bleaching, extreme weather events, increased water stresses and droughts, slower economic growth and more people living in poverty. In order to limit global warming as per the Paris Climate Agreements, policy and business action need to be accelerated and ambitions need to be raised (IPCC 2018a). "Limiting global warming to 1.5 °C would require rapid, far-reaching and unprecedented changes in all aspects of society", according to IPCC Chair Lee (IPCC 2018b: 1).

More broadly, the key sustainability challenges have been formalized in 17 sustainable development goals (SDG), developed from the Millennium Goals, including challenges around climate action, clean water and sanitation, zero hunger and reducing inequality. They were adopted by the UN in 2015 calling for new collaborative solutions by governments, businesses, researchers and civil society organizations (George et al. 2016). These grand challenges may be viewed as "the

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biggest business opportunity of our times", as suggested by Porter and Kramer (2011). Resolving such challenges requires major innovation efforts, at the level of individual products and services, but also more broadly at the level of business models and social innovations, and major system-level transitions (Adams et al. 2016).

This edited collection—*Innovation for Sustainability*—seeks to highlight important opportunities and challenges for business in this regard.

While these themes are tremendously important, they are certainly not new. In fact, there are many books and thousands of journal articles written at the intersection of business and sustainability (Bansal and Song 2017). Also, the recognized need to tackle climate change is not new, but the evidence base is now ever more paramount, showing the pressing needs for business and policy to take action (IPCC 2018a, b). As a response, there are increasing numbers of academic contributions discussing the need for sustainability-oriented innovation (e.g. Adams et al. 2016; Hansen et al. 2009) and sustainable business model innovation (e.g. Stubbs and Cocklin 2008; Boons and Lüdeke-Freund 2013). However, with this progress the field has grown exponentially leading to divergence in the views and the conceptualizations used.

To bridge this gap, our edited collection incorporates contributions in the intersection of innovation and sustainability literature, representing a diversity of approaches in business, management and engineering. We also include cross-disciplinary approaches embedding, for example, political research, system analysis and experimental research. In doing so, we aim to provide a comprehensive overview of the opportunities and challenges related to innovation for sustainability. Combining work from both emerging and established scholars, this book examines the topic from four perspectives: (1) Systemic approach (2) Strategy and leadership, (3) Measurement and assessment, and (4) Tools, methods and technologies. These are preluded by short practitioner perspectives to introduce the four perspectives.

Furthermore, this book aims to be "solutions-driven", providing both academically sound but also practically applicable insights for fostering sustainable innovation needed to tackle pressing sustainability issues. As a whole, the compilation of chapters provides a reflective as well as a critical understanding of the challenges that need to be solved. Thus, from a business perspective the book provides multiple insights on how to approach innovation for sustainability, but without one predefined "recipe". Rather, it gives a critical insight on different aspects of Innovation for Sustainability.

Overall, this book aims to be a key resource for Master students, Ph.D. students and MBAs, but also scholars, practitioners and decision-makers wanting to gain essential knowledge about the field of innovation for sustainability.

Defining Innovation for Sustainability

This book pursues to push forward the convergence in the disciplinary traditions of innovation management and sustainable business. While these fields have partly developed separately, we see the pursuit of positive environmental and social goals as innate to any innovation process. As such, this suggests that a separate field of *Innovation for Sustainability* would not be necessary in the future, as all innovation processes should include clear and traceable positive environmental, social and economic implications. This relates to what P. Drucker already wrote in 1954: "Every single social and global issue of our day is a business opportunity in disguise". With this progress in mind, in this book we are suggesting an integrative definition of *Innovation for Sustainability (IfS)*, building on sustainability and innovation management fields. This definition is grounded both in our own thinking, as well as the variety of contributions in this book.

Innovation can be broadly described as a process of turning opportunity into new ideas and putting these into widely used practice (Tidd et al. 2005). It is vital for organizational survival, long-term growth and organizational competitive advantage (Teece 2010). Growing global resource, climate and humanitarian challenges have spurred organizations to embed social and environmental aspects as part of their economic value creation. Indeed, many companies nowadays see that long-term competitiveness can only be achieved this way (Hart and Milstein 2003; Porter and Kramer 2011). Thus, for an increasing number of firms, sustainability implies the creation, delivery and capturing of all three dimensions of value—economic, social and environmental—as part of their business model (see, e.g., Boons et al. 2013; Inigo et al. 2017).

Accordingly, we argue that companies should (and do) increasingly pursue *Innovation for Sustainability*—rather than innovation as a purely profit-oriented pursuit (Adams et al. 2016). Furthermore, IfS is seen as both a process and an outcome of pursuits that increase economical, ecological and social aspects of value creation. Such innovation is all but easy, but when successful, the rewards are high for both innovating actors as well as the societies they are embedded in (e.g. Porter and Kramer 2011). In fact, IfS requires companies to foster complex transformation at both organizational and societal levels (e.g. Markard et al. 2012; Inigo and Albareda 2016).

Innovation for Sustainability is an overarching umbrella concept that relates to the growing development of new products and services, processes, technologies, organizational practices, business models and even whole "systems" at networks such as cities (Fig. 1.1) (Adams et al.

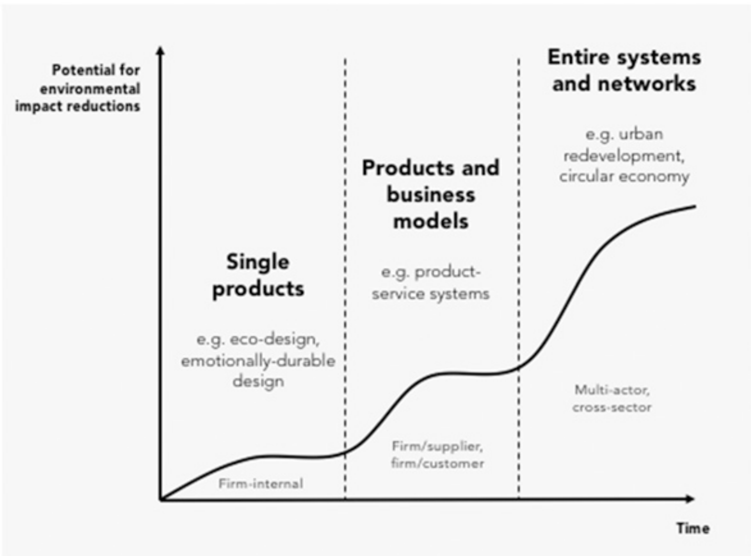

Fig. 1.1 Innovation for sustainability spectrum (Adapted from Konietzko et al. 2018; Adams et al. 2016 and Ceschin and Gaziulusoy 2016)

2016). It can also be regarded as a commercial introduction of products, services or product-service combinations, which, based on traceable assessment, has clear environmental and (or) social life cycle benefits over prior versions (Hansen and Grosse-Dunker 2013). Organizations of all types and sizes are pursuing such innovations. However, it should be noted that sustainability-oriented system-based innovations strongly benefit from hybrid forms of businesses (e.g. benefit corporations and social enterprises) that are emerging where the profit motif is less dominant, while social and environmental motives come to the foreground (Battilana and Dorado 2010).

In existing businesses, IfS is an *intentional change* to an organization's philosophy and values and to its products, services, processes or practices to create social and environmental value as well as economic returns (Adams et al. 2016). In new and emerging businesses, it is often about the *intentional design* of such organizations with social and environmental value. It is apparent from separate innovation and investment literatures that often one dimension (e.g. environmental focus such as cleantech or a social focus) is more dominant (Bocken 2015). As a result, in the more advanced and committed hybrid organizations, innovation for sustainability is growing as a complex adaptive system (Inigo and Albareda 2016) expanding innovation dynamics towards economic and social transformations.

In summary, IfS may be classified by the *innovation type* (e.g. technology, process, product/service or business model), the *dominant target* (ecological and/or social, coupled with economic) (Hansen et al. 2009) and *level of disruption* (incremental, radical) (Plieth et al. 2012). Typically, the assessment of impact will take a life cycle or value chain perspective (Hansen et al. 2009).

Based on the above discussion, we propose the following integrative definition for ***Innovation for Sustainability (IfS)***:

> Innovation for Sustainability is about the intentional introduction of (radically) new or (incrementally) improved products and services or entire systems, which, based on traceable comparative analysis, lead to environmental and (or) social benefits that surpass those of the prior products, services, or systems.

While this definition intends to be broad and inclusive, it is noteworthy to mention that the research field of innovation and sustainability is still nascent and the terminology has not converged. This is observable throughout the 23 chapters of this edited collection, where authors discuss concepts such as eco-innovation, sustainable innovation, sustainability-oriented innovation, sustainable-business model innovation. This is certainly a reflection of cross-disciplinary nature of the author teams, as well as the field at large. However, it might also provide to be of hindrance in the scholarly development of the field if authors use diverse concepts when referring to the same phenomena. As such, we believe that the converge in the terminology will gradually take place in the coming years, but at the moment the diversity of views might be beneficial in order to tease out all the necessary perspectives. Hopefully, our book will help in its part in facilitating the conceptual development and cross-disciplinary understanding of innovation for sustainability.

Structure and Contents of the Book

'Innovation for Sustainability'—will incorporate four parts: (1) the big picture (systems approach), (2) strategy and leadership, (3) measurement and assessment, as well as (4) tools and metrics for sustainable innovation. Figure 1.2 visually summarizes the four parts in the book, which are mutually complementary, and provide an overarching view to innovation for sustainability, as discussed in the following.

Part I on this book focuses on the **Big Picture** of the phenomenon of innovation for sustainability. Together these five chapters develop the managerial understanding of the topic, including a critical approach to IfS. The first two chapters summarize and reflect insights from the academic literature. While Chapter 2 proposes an interesting discussion about the three main ontologies adopted by researchers, Chapter 3 provides an in-depth bibliometric literature review that classifies their dissemination. Chapters 4 and 5 provide detailed evidence based on how companies engage in IfS and build different business approaches: environmental factors affecting businesses (Chapter 4), and different profiles of circular business model innovation (Chapter 5). Chapter 6 then

Fig. 1.2 Overview of book structure

explores the role of policymakers to support eco-innovation as key drivers to transition towards a green economy. In detail:

- **Chapter 2** adopts a system view to innovation for sustainability and introduces three perspectives on the role of business as a driver for change in innovation and Sustainable Development. These include sceptical, pragmatic and idealistic perspectives, each involving a complex adaptive system analysis of the role of businesses. Based on these perspectives, the chapter provides a critical and reflective outlook to the challenges and opportunities of innovation for sustainability.
- **Chapter 3** contributes to the big picture through a literature review and bibliometric analysis on innovation for sustainability. The impact and dissemination of this literature are classified five key discussions: strategic, operational, organizational, collaborative and systemic IfS.

The bibliometric analysis shows how IfS literature has expanded from Business Management, Strategy, Innovation and Operations to connecting to the main discussions in Environmental Sciences, Environmental Engineering and Ecology.

- **Chapter 4** studies how environmental factors affect the engagement of businesses in innovation for sustainability. Looking at the literature on dynamic capabilities and socio-technical transitions, the author draws on empirical evidence of eight cases of companies framing three different degrees of dynamism: reactive, challenging the environment and contributing to system building.
- **Chapter 5** studies how companies in different settings engage in developing circular business model innovation. Based on case analysis in Denmark, the authors build a model for circular business based on three main approaches: internal, hybrid and systemic circular business model innovation.
- **Chapter 6** investigates business-driven ecological innovation in green growth strategies. The authors explore the linkages between green growth and eco-innovation. The main argument is that the growing fields of eco-innovation and sustainable business models are drivers towards the transition to a green economy and must be adopted and supported in governmental policy strategies.

Part II of the book highlights **The Strategic and Leadership Aspects of Innovation for Sustainability (IfS)**. The different chapters illustrate the nature and practice of innovation-based sustainable business strategies on the basis of state-of-the-art theory and the results of a number of original case studies. Illustrations range from retail businesses (Chapter 10), fashion companies (Chapter 11), horse-industry entrepreneurs (Chapter 12) to more established corporates (see Chapters 8 and 9). Given that the main building blocks of innovation are individuals' knowledge and ideas, the way employees are led and managed is a crucial factor in determining whether organizations are able to execute those innovation-based sustainable business strategies. Therefore, in this part, also leadership practised for Ifs is highlighted in Chapters 7, 8 and 9.

- **Chapter** 7 explores the leadership challenges associated with sustainability by highlighting the current research evidence on the links between leadership and (sustainable) innovation.
- **Chapter** **8** provides an overview of the key leadership challenges in relation to sustainable innovation projects in large businesses. Examples from practice are provided and it shows that project managers are challenged by gathering the right information as well as to allocate resources wisely within sustainable innovation projects.
- **Chapter** **9** provides the results of a case study on systemic innovation. This case shows that business leaders tend to hold back attempts at systemic innovation for sustainability due to structural impediments, uncertainty avoidance and conflicting aims within and between firms.
- **Chapter** **10** shows on example how business models in the retail sector can be innovated in order to ensure smarter and more sustainable business models on the basis of a normative framework. Central to this framework are: redesign, experimentation, service-logic, the circular economy, alliances, results and three-dimensionality.
- **Chapter** **11** features localism as a strategy for business model innovation for sustainability. As a strategy, localism can generate various forms of shared value. The geographic proximity seems to enable reconnections between resources, people, place, community and through environment that correlate with sustainability.
- In **Chapter** **12** examples of strategies for enabling sustainable entrepreneurship are presented. This chapter shows that the choice for a specific sustainable entrepreneurship strategy highly depends on the valuation of environmental, economic and social sustainability factors.

Part III of the book focuses on **Measurement and Assessment of Sustainable Innovation**. As a whole, the five chapters in this part provide a good overview of the state of the art in the field. The first two chapters (Chapters 13 and 14) provide insights of the broad-based challenges and opportunities in measuring and assessing innovation for sustainability. The remaining three chapters, on the other hand, provide more detailed evidence on the assessment and details of innovation processes for sustainable innovation. They include the interesting approach of "reversing materiality" (Chapter 15), design and systems thinking approach to sustainability impact (Chapter 16), as well as an examination of how strategic environmental goals affect product innovation (Chapter 17).

- **Chapter 13** details the measurement challenges in innovation performance measurement in general and combines those with the innovation for sustainability context. As a result, the chapter provides useful insights into how academics and practitioners can design different measurement schemes.
- **Chapter 14** develops a series of propositions regarding the assessment of the impact of sustainable business models. Here, the authors outline particular principles that would ideally describe the breadth and detail of such assessment.
- **Chapter 15** describes how companies can move from reactive materiality assessments to a more proactive approach. In particular, the authors suggest that firms can embed sustainable development goals (SDGs) in their strategic activities, effectively "reversing materiality".
- **Chapter 16** draws from design sciences and systems thinking in describing how companies can better scale their sustainability impact. The chapter goes through principles that could help companies to be more adaptive and design-driven and provides several illustrative examples from practice in this regard.
- **Chapter 17** presents a mixed methods approach on explaining how companies' strategic environmental goals affect product innovation. The authors find quantitative evidence that pursuing environmental goals can be successfully aligned with product innovation, and they illustrate these with qualitative insights.

Part IV describes ***Tools, Methods and Technologies That Support Innovation for Sustainability***. It includes novel perspectives on tools and methods for IfS and explores the role of new technologies and developments. The first two chapters (Chapter 18 and 19) discuss the topic of experimentation for sustainability and the circular economy and provide company cases as examples. Chapters 19 and 21 contribute to the broader discussion on circular economy. Chapter 20 is about games and gamification and their role in sustainable innovation. Chapters 22 and 23 reflect on the role of digital technologies and platforms and their impacts on sustainability.

- **Chapter 18** discusses the topic of Experimentation for Sustainability. It contrasts "business experimentation for sustainability" to drive IfS with experimentation in the natural sciences. It provides insights on how the corporation Procter & Gamble experiments during the sustainable innovation process.
- **Chapter 19** describes a process-oriented approach to experimenting with circular business models including five broad stages. The case of the tools renting service pilot called Liiteri is introduced, which highlights various challenges and opportunities identified across the different process steps.
- **Chapter 20** describe game-based approaches to sustainable innovation and how two game-based approaches—serious games and gamification—have been applied to sustainable innovation. Through various examples, the chapter explores potential merits and drawbacks to game-based approaches.
- **Chapter 21** talks about the potential role of the circular economy as a particular "imaginary" and approach to drive institutional changes for sustainable innovation. The case of Sitra, the Finnish Innovation Fund, is described. It was found that the circular economy lens has a potential to create collective meaning towards innovation which fits the Finnish culture.
- **Chapter 22** focuses on the role of digital technologies in innovation for sustainability. It explores the linkages between specific digital technologies and their economic, social and environmental impacts, as well as potential positive and negative implications.
- **Chapter 23** discusses the potential role of online platforms in the circular economy. It develops a framework about the role of online platforms in the circular economy including online platforms as enablers of circular economy *markets*; ways to *operate* product-service systems; and places to *co-create* novel products and services.

The Way Forward—Better World with Innovation for Sustainability?

Is a better world possible with Innovation for Sustainability? This book presents a big picture view on IfS, notions of strategy and leadership, approaches to measurement and assessment, as well as views on tools methods and technologies to source the latest thinking and trends. Topics like the circular economy, digital platforms, experimentation and gamification emerged in this edited volume with international cross-disciplinary teams. As with any innovation, the outcome of such developments is hard to predict or control. For example, will car-sharing business models actually reduce the number of cars on the road or sustain incumbents' car sales? (see, e.g., Boons and Bocken 2018) Are energy efficient technologies (e.g. lights, appliances) leading to negative rebound effects such as using these more, because they are "efficient" anyways? (Greening et al. 2000)

However, as suggested in our previously mentioned definition of IfS, the intentional design and assessment of impact are crucial. This means IfS is performed by entrepreneurial thinkers in all kinds of organizations (e.g. start-ups, SMEs, hybrid organizations, large business), but also by citizens using and co-creating newly designed products and services. Moreover, policymakers are paving the way for different levels of innovation. The success of IfS thus depends on involvement at all actors at all levels, which has long been recognized in transitions studies (Geels 2002; Markard et al. 2012). However, a proactive stance as well as involvement of actors at all levels becomes ever more pressing with increasingly pressing sustainability issues.

This book is also about *change*—exploring what is next. Our main goal as editors was to search for trailblazers and pioneering trends in research and practice. Indeed, many of the chapters introduce novel organizational practices and strategies, as well as improved ways to assess and measure impact of innovation in sustainability context. Furthermore, much of the research included in this book shows the need for IfS to integrate with trends such as digitalization, as well as experimentation and gamification.

This book has also shown ways to *consolidation* of organizational practices and the implementation of sustainable business models.

We are entering the third decade on the twenty-first century. This will be an important period for business, sustainability and innovation. IfS displays multiple levels of action needed to interconnect individual sustainable leadership and entrepreneurship to the other levels of organizational transformation and systems transitions towards sustainable development. We see how business is becoming problem-solvers, aiming to provide solutions to grand challenges and fostering ways to adopt and build on SDG. IfS is not a secondary goal anymore; it is a core approach for creating value at multiple levels: products, services, business models and system-level transitions. This reflects a necessary way forward for scholarly development. Beyond using sustainability as a context or target for innovation, we ask scholars to be even more ambitious in their attempts to theorize and conceptualize IfS, as well as developing interdisciplinary action research-based approaches. For instance, recent attempts draw from circular design principles and combine those with a business model approach from management studies to advance understanding of circular economy transitions (e.g. Bakker et al. 2014; Bocken et al. 2016; den Hollander et al. 2017).

All in all, we have sought to contribute with a book that crosses topics, disciplines, as well as business and academia. We hope it will open up further debate and spur action to resolve our world's most pressing challenges through the lens of Innovation for Sustainability.

References

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Bakker, Conny, Marcel den Hollander, Ed Van Hinte, and Yvo Zljlstra. 2014. *Products that last: Product design for circular business models*. Delft: TU Delft Library.

Bansal, Pratima, and Hee-Chan Song. 2017. "Similar but not the Same: Differentiating corporate sustainability from Corporate Responsibility." *Academy of Management Annals* 11 (1): 105–49.

Battilana, Julie, and Silvia Dorado. 2010. "Building sustainable hybrid organizations: The case of commercial microfinance organizations." *Academy of Management Journal* 53 (6): 1419–40.

Bocken, Nancy M. P. 2015. "Sustainable venture capital–catalyst for sustainable start-up success?" *Journal of Cleaner Production* 108: 647–58.

Bocken, Nancy M. P., Ingrid de Pauw, Conny Bakker, and Bram van der Grinten. 2016. "Product design and business model strategies for a circular economy." *Journal of Industrial and Production Engineering* 33 (5): 308–20.

Boons, Frank, and Nancy Bocken. 2018. "Towards a sharing economy–Innovating ecologies of business models." *Technological Forecasting and Social Change* 137: 40–52.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Boons, F., C. Montalvo, J. Quist, and M. Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Ceschin, Fabrizio, and Idil Gaziulusoy. 2016. "Evolution of design for sustainability: From product design to design for system innovations and transitions." *Design Studies* 47: 118–63.

den Hollander, Marcel C., Conny A. Bakker, and Erik Jan Hultink. 2017. "Product design in a circular economy: Development of a typology of key concepts and terms." *Journal of Industrial Ecology* 21 (3): 517–25.

Drucker, Peter Ferdinand. 1954. *The practice of management: A study of the most important function in America society*. New York: Harper & Brothers.

Ferraro, Fabrizio, Dror Etzion, and Joel Gehman. 2015. "Tackling grand challenges pragmatically: Robust action revisited." *Organization Studies* 36 (3): 363–90.

Geels, Frank W. 2002. "Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study." *Research Policy* 31 (8–9): 1257–74.

George, Gerard, Jennifer Howard-Grenville, Aparna Joshi, and Laszlo Tihanyi. 2016. "Understanding and tackling societal grand challenges through management research." *Academy of Management Journal* 59 (6): 1880.

Greening, Lorna A., David L. Greene, and Carmen Difiglio. 2000. "Energy efficiency and consumption—The rebound effect—A survey." *Energy Policy* 28 (6–7): 389–401.

Hansen, Erik G., and Friedrich Grosse-Dunker. 2013. "Sustainability-oriented innovation." In *Encyclopedia of corporate social responsibility*, 2407–17. Berlin and Heidelberg: Springer.

Hansen, Erik G., Friedrich Grosse-Dunker, and Ralf Reichwald. 2009. "Sustainability innovation cube—A framework to evaluate sustainability-oriented innovations." *International Journal of Innovation Management* 13 (04): 683–713.

Hart, Stuart L., and Mark B. Milstein. 2003. "Creating sustainable value." *Academy of Management Perspectives* 17 (2): 56–67.

Inigo, Edurne A., and Laura Albareda. 2016. "Understanding sustainable innovation as a complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.

Inigo, Edurne A., L. Laura Albareda, and Paavo Ritala. 2017. "Business model innovation for sustainability: Exploring evolutionary and radical approaches through dynamic capabilities." *Industry and Innovation* 24 (5): 515–42.

IPCC. 2018a. Summary for policy-makers. Intergovernmental Panel on Climate Change (IPCC). Accessed October 9, 2018. Available at: http://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf.

IPCC. 2018b. IPCC press release. Intergovernmental Panel on Climate Change (IPCC). Accessed October 17, 2018. https://www.ipcc.ch/pdf/press/pr_outreach_vietnam_2018.pdf.

Konietzko, Jan, Nancy Bocken, and Erik Jan Hultink. 2018. "Business model experimentation for the circular economy in a service network context." In *25th IPDMC: Innovation and product development management conference*, Porto, June 10–13.

Markard, Jochen, Rob Raven, and Berhard Truffer. 2012. "Sustainability transitions: An emerging field of research and its prospects." *Research Policy* 41 (6): 955–67.

Plieth, Hanna, Angelika C. Bullinger, and Erik G. Hansen. 2012. "Sustainable entrepreneurship in the clothing industry: The case of manomama." *The Journal of Corporate Citizenship* 45: 121–34.

Porter, Michael E., and Mark R. Kramer. 2011. "The big idea: Creating shared value." Jan–Feb.

Rockström, Johan, Will Steffen, Kevin Noone, Asa Persson, F. Stuart III Chapin, et al. 2009. "A safe operating space for humanity." *Nature* 461: 472–75.

Steffen, Will, Asa Persson, Lisa Deutsh, Jan Zalasiewics, Katherine Williams, Carole Crumley, Paul Crutzen, Carl Folke, Line Gordon, Mario Molina, Veerabhadran Ramanathan, Johan Rockström, Marten Scheffer, Joachim Schellnhuber, and Uno Svedin. 2011. "The Anthropocene: From global change to Planetary Steardship." *Ambio* 40: 739–61.

Stubbs, Wendy, and Chris Cocklin. 2008. "Conceptualizing a 'sustainability business model.'" *Organization & Environment* 21 (2): 103–27.

Teece, D. J. 2010. "Business models, business strategy and innovation." *Long Range Planning* 43 (2–3): 172–94.

Tidd, Joe, John Bessant, and Keith Pavitt. 2005. *Managing innovation integrating technological, market and organizational change*. Hoboken: Wiley.

Part I

Systemic View—the Big Picture

Lehman Brothers of Environment

One must wonder what will it take before companies change from pure economics-driven leadership into a model that considers environmental, social and economical values.

We all know what was needed before the system was cleaned up in the world of financing—the Lehman Brothers. Do we need to lose a city, a country or entire continent to pollution—losing in any case millions of lives—before we will set up rules for businesses restricting their operations that negatively impact the environment?

Basic rules of accounting are only evaluating success through profits; however, there should be ways to take into account the impact beyond money. When working in a family-owned company, the values of the owners can make a big difference, as they can set the standards for the company to make decisions which create a path to a better world.

Electrification is a business area inside Danfoss, where we have an opportunity to make a positive impact on environment. Electrification is a sustainable innovation that not only creates economical value for Danfoss and to its customers through efficiency, but also enforces environmental sustainability and social well-being at the same time.

Therefore, I believe I am privileged to be in this position in life and in business. I can only wish that the different methods described in this book would be soon adopted to the official accounting rules as well as the world of financing, driving the markets towards a direction that provides better world for all of us.

Kimmo Rauma, Danfoss Editron

Innovation for Sustainability in Banking Sector

Our vision about the world we live in is marked not only by a sense of urgency, but also by a sense of opportunity.

Financial industry is living its sustainability tipping point. Four forces are reshaping this new era: (1) a global agenda with standouts such as the Paris Agreement on climate change and the SDGs; (2) the tremendous market opportunity generated by this agenda; (3) the increasing pressure by institutional investors and finally (4) the growing regulation and soft-regulation.

Now it is time to reimagine the role of banking in society. Banks need to redefine their purpose, a purpose that is as transformational as massive, aimed at having a positive impact on people's lives. Our purpose at BBVA is to bring the age of opportunity to everyone.

Purpose-driven banks mean to mainstream innovation for sustainability. We need to embed the impact on people's lives in the whole innovation process. Only this human-centric approach will lead us to build trust and ensure enduring companies.

In the case of banks, there are relevant examples of this innovation for sustainability. One of them is the use of exponential technologies (AI, big data, blockchain…) to create solutions to promote financial inclusion, financial health and advice to take better financial decisions. Another one is sustainable finance where we see innovations such as green/social bonds or green loans. A third source is the umbrella of extreme transparency. As our Group Executive Chairman has said: "*Soon, a financial ecosystem will emerge that will work in a different way, based on extreme transparency and where the client will be the winner*".

But the most promising is that we start to see more than ever the level of complicity within the industry to think big. The Principles for Responsible Banking promoted by UNEP FI and 28 banks to be launched in November 2018 are a great example of multi-actor and cross-sector innovation for sustainability. They will define the standards and the accountability model of this new banking sector.

Antoni Ballabriga, Global Head of Responsible Business at BBVA, European banks representative at UNEP FI Global Steering Committee, Chair of the Sustainable Finance Working Group at the European Banking Federation

2

Innovation for Sustainability: Sceptical, Pragmatic, and Idealist Perspectives on the Role of Business as a Driver for Change

Paavo Ritala

Introduction

There is a strong promise and potential of innovation for sustainability. It includes themes such as sustainable business models (Boons and Lüdeke-Freund 2013; Bocken et al. 2014), sustainability-oriented innovation (SOI) (Adams et al. 2016), sustainability transitions (Markard et al. 2012), and shared value (Porter and Kramer 2011). The common thread in many of these discussions is the hope that the private sector, together with other organizations and institutions, can develop solutions that resolve the grand challenges, such as climate change, social inequality, and environmental degradation. As firms control most of the productive resources globally available (Porter and Kramer 2011), it makes sense to look for answers to sustainability problems from the innovative pursuits and new technologies pushed forward by companies.

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However, there are many criticisms of corporate sustainability and related innovation. For instance, Shevchenko et al. (2016) critically examine the discrepancy between what the academic literature says about sustainability and how sustainability is actually practised. They find that firms tend to incrementally offset negative environmental and societal impacts, rather than eliminate them. This is especially true for large firms, which face structural constraints and major challenges in transitioning to new sustainable business models (see also Hockerts and Wüstenhagen 2010; Schaltegger et al. 2016; Ritala et al. 2018). These arguments are further supported by powerful criticisms of corporate social responsibility and shared value initiatives in that they miss the inherent tension between corporate profit-seeking and social and environmental issues (Banerjee 2008, 2010; Devinney 2009; O'Toole and Vogel 2011; Crane et al. 2014).

I argue that we need to take a step back and take a broader view on how firms can (or cannot) contribute to sustainable innovation. If innovations are examined only in their local context (e.g. whether a new technology improves energy efficiency), we are not able to understand whether they lead to actual improvements in the global context. Some literature incorporates this view. For instance, Adams et al. (2016) examine SOI with a framework that distinguishes between "operational optimization", "organizational transformation", and "systems building". Of these types of innovation, the first one reduces harm, the second one creates shared value, and the last one creates net positive impact and reaches beyond the firm to enable institutional change. It is quite obvious that we need all these types of innovation, but only the last can be recognized as "truly sustainable" (see also Shevchenko et al. 2016). Relatedly, Markard et al. (2012) review the literature on sustainability transitions. This literature recognizes that technological and social developments are embedded in complex relationships, which develop over time in national and global contexts.

Therefore, in analyzing "innovation for sustainability", it is essential to look at the big picture, given the highly interconnected nature of technological development and social progress in socio-technical transitions (Geels 2010; Markard et al. 2012; Schaltegger et al. 2016).

For instance, in analyzing individual innovations that have sustainability-related motivations, they still might end up having negative system-level outcomes (e.g. the "rebound effect" of sharing economy business models, see Acquier et al. 2017). Although companies might have the best intentions, when we look at the economy as an interconnected and evolving system, we realize that is difficult and sometimes impossible for individual economic actors to assess the outcomes of their activities within the system.

Here, I critically reflect the emerging paradigm of "innovation for sustainability" via *complex adaptive systems* lenses. Complex adaptive systems involve components (e.g. individuals or organizations) that interact with each other, adapt or learn through these interactions, and self-organize without being controlled or managed by any singular entity (Holland 1995). Although sustainable innovation has been viewed from complex adaptive systems lenses within a firm-level analysis (see Inigo and Albareda 2016), I adopt here the broader perspective of "complexity economics" (Beinhocker 2006). Analysis of this level views the global economy as a complex adaptive system, following similar evolutionary patterns as biological ecosystems (see also Mitleton-Kelly 2003). Economic, social, and ecological systems are fundamentally interconnected, and changes are one component of any of these systems that have effects on other parts of the system, as well as other systems, creating *coevolutionary* development trajectories (see, e.g., Schaltegger et al. 2016). From the innovation perspective, this means that improvements in one part of the system might create benefits in other parts as well, but these interdependencies might also be negative. Complex systems often involve feedback mechanisms, such as rebound effects (e.g. seemingly sustainable innovation creates more demand and total consumption rises), positive and negative externalities, and unpredictable non-linear developments.

In this chapter, I critically reflect *when and if private-sector driven sustainable innovation is actually "sustainable" from a systems perspective*. Given the complexity of the topic, I do not aim to propose simple solutions. Instead, I briefly discuss the issue from sceptical, pragmatic, and idealist perspectives, portraying the viewpoints reflected in the current sustainability and innovation literature. This categorization is my own and does not necessarily reflect the worldview of the cited authors and works, nor represents the state of the art in its entirety. In any case, this categorization helps to explicate the different potential stances towards innovation for sustainability. It purposefully contrasts scepticism and idealism as the extreme positions, while the "middle road" of pragmatism adopts less normative stances and focuses on the contextual heterogeneity and diversity of the topic as it appears in the empirical reality (on pragmatism, see, e.g., Almeder 2007). Table 2.1 summarizes them up-front, and more detailed discussions ensue in the following sections.

The Sceptical Perspective

The sceptical perspective on innovation for sustainability departs from the assumption that gradual improvements in environmental and social aspects are possible, but the majority of private-sector innovation activity focuses on economic performance and growth. Thus, this perspective involves scepticism towards whether "environmental and social sustainability" can actually be a goal that the current economic order can support. Therefore, this perspective ultimately recognizes the classical worldview of *homo economicus*: individuals as profit-maximizers, and similarly, firms and their owners largely following profit-maximizing goals and putting those ahead of any other goals. Vogel (2005) summarizes this view by stating that "unfortunately there is no evidence that behaving more virtuously makes firms more profitable … the market for virtue is not sufficiently important to make it in the interest of all firms to behave more responsibly".

There are many good reasons to believe that this view is at least partially accurate (for discussions, see, e.g., Husted and Salazar 2006; Hawn et al. 2018). If we look at near-term history, economic profit has been the leading force of innovation, for small and large firms. From this perspective, sustainable innovation of any kind needs to be viewed very critically, as the implications tend to be incremental and prioritize economic growth (see also Shevchenko et al. 2016). In addition, several authors suggest that many initiatives designed to integrate economic, social, and environmental aspects might end up skewed towards the

Table 2.1 Sceptical, pragmatic, and idealist perspectives on innovation for sustainability

	Sceptical perspective	Pragmatic perspective	Idealist perspective
Key tenets	Innovation for sustainability is ultimately bounded by the systemic constraints of a capitalist society Vicious cycles of social and ecological degradation and inequality are likely Representative studies: Vogel (2005), Frynas (2005), Shevchenko et al. (2016)	Innovation for sustainability can create progress and synergy Overall progress takes place, but it is highly heterogeneous across geographic, institutional, and organizational contexts Representative studies: Boons and Lüdeke-Freund (2013), Bocken et al. (2014)	Innovation for sustainability resolves global problems and is inevitable Virtuous, net-positive cycles across economic, environmental, and social domains are assumed Representative studies: Hart and Christensen (2002), Falk and Ryan (2007), Porter and Kramer (2011)
Innovation outcome	Gradual improvements in environmental and social aspects, with the main focus on economic performance	Innovations that are socially and/or environmentally more sustainable, including varying levels of synergies with economic performance	Triple-bottom-line innovation (simultaneous improvement in economic, social, and environmental dimensions)
System-level dynamics in the economic domain	Innovation creates more demand and subsequent supply, even if the number of sustainable solutions increases	Sustainable innovation gains in market share; economic losses ensue for some unsustainable market actors	Sustainable innovation outpaces other alternatives; reduction in total consumption; degrowth in some areas
System-level dynamics in the environmental domain	Increase in total consumption creates continuing demand for non-renewable resources; overall environmental degradation continues	Slowing pace of environmental degradation; deviation of local improvements	The usage of non-renewable raw materials drops considerably; environmental ecosystems regenerate
System-level dynamics in the social domain	Increasing inequality across the value chains; rapid polarization of global and local wealth	Local improvements in stakeholder conditions; polarization between regions and economies continues gradually	Overall improvement of stakeholder conditions; social equality improves globally

first one. For instance, Morrison-Saunders and Fischer (2010) criticize the tendency of contemporary, integrated sustainability assessments by companies to ultimately favour trade-offs towards socio-economic benefits at the expense of the environment (see also Fonseca et al. 2014). Furthermore, some authors warn about relying too much on "technological fatalism" (see Arias-Maldonado 2016), given that the sustainability challenges are unlikely to be resolved merely via isolated technological solutions. Finally, Frynas (2005) points out that despite local improvements, companies' sustainability initiatives often remain local and fail to address macro-level effects and contexts.

In the *economic* domain, a sceptical perspective views sustainable innovation potentially as a double-edged sword at the system level. For instance, Acquier et al. (2017) refer to the "rebound effect" that creates a paradoxical context for sharing economy business models. As new innovations emerge that pursue sharing resources more efficiently, this sharing might lead to overindulgence of those resources and even end up increasing the total demand. Similar dynamics are easy to expect with other categories of sustainable innovation. Innovation, in general, creates more demand for new products and services, as witnessed in technology-push literature (Dosi 1988). Even if much of the innovation space is intangible today, it might be unavoidable that new products, services, and interaction are introduced in the markets. Coupled with the rising purchasing power of the increasing number of new consumers across the world, the overall effect of increasingly sustainable production might still result in a rapid increase in supply and demand.

From the *environmental* viewpoint, this type of development is a particularly bad scenario. From the systems perspective, the overall rise in consumption might well lead to continuing demand for non-renewable resources, as well as environmental degradation. This demand is certainly being witnessed at the moment, despite the good attempts made by national and supra-national policy initiatives. Several sources argue that environmental sustainability is unlikely to be attained with growing production (Hueting 2010; Jackson and Senker 2011). Therefore, from a sceptical perspective, innovation (even if "sustainable") might lead to the vicious circle of growing production and related environmental harm.

On the *social* side, the sceptical perspective expects rising inequality across value chains, as well as rapid polarization of global and local wealth. Stiglitz (2012) provides a thorough critique of the market economy in this regard. According to him, even when markets are stable, they tend to lead to increasing levels of inequality. Although this has been mostly a problem in developing economies, Stiglitz notes that it is increasingly a problem in Europe and the USA as well. Piketty (2014) further argues that as investment profits are growing at a faster pace than wages, the increasing trend of inequality is built in the current system, and typically corrected only through major crisis events, such as world wars. Innovations and related growth might do little to resolve inequality and other social problems.

The Pragmatic Perspective

The pragmatic perspective adopts a middle ground between the sceptical outlook on institutional and organizational constraints for sustainability and the optimism surrounding new initiatives, innovations, and technologies. Thus, the pragmatic perspective recognizes that innovation and technological development in general can solve environmental and social issues and that there might be synergies among ecological and social development and economic performance (e.g. Tang et al. 2012). For instance, the emerging literature of sustainable business models provides a host of examples where firms adopt competitive strategies that rely—at least partly—on environmental and social innovation (Boons and Lüdeke-Freund 2013; Bocken et al. 2014; Ritala et al. 2018).

From the *economic* point of view, a pragmatic approach recognizes that there will be major contextual and local differences in the success of sustainable innovation. In many fields, sustainable innovations will achieve market share and gain competitive advantages (Bocken et al. 2014), which ends up generating economic losses to "unsustainable actors". This transformation process will reconfigure the global economy, but major differences will remain across industries and countries. In addition, the recognition of the economic merits of sustainable innovation is likely to be slow and gradually develop prominence among business owners and investors (see, e.g., Hawn et al. 2018).

Similarly, for *environmental* issues, innovations can significantly slow the pace of environmental degradation, but there will still be regions where the institutional forces or mere population growth curves support less favourable development. In addition, as there are major differences in cultural and institutional support for environmental issues across contexts (Gelissen 2007), this is likely to also reflect on the types of innovation adopted and seemed (il)legitimate. In practice, we are currently witnessing major deviations between different environmental policies and consumption habits within developed and emerging markets, as well as the development of business-originated "eco-innovations".

For *social* progress, it is pragmatic to assume that there will still be increasing polarization between different regions, even if innovation might enable some previously neglected regions to flourish (Anderson and Billou 2007; Prahalad 2012). Overall, the developments in economic, social, and ecological systems will lead to a world where some regions will benefit, some societies will grow more equal and prosperous, while some will spiral further into a worse outlook. Innovation for sustainability has the potential to either accelerate this development (given that its adoption varies) or to increase global equality in terms of, for example, working conditions and fair pay (see, e.g., Porter and Kramer 2011).

The Idealist Perspective

The idealist perspective assumes that innovations in technologies, business models, and consumption habits can overturn the current negative effects and ignite the economy-ecology-society link in a virtuous cycle. In essence, such "triple-bottom-line" innovation is the ideal form of innovation, given its benefits for all domains. Some authors suggest that such *systems transformation* is the most advanced level of SOI, and at the same time, the most challenging (Adams et al. 2016). An idealist perspective departs from the notion that systems transformations are not only possible but also are effectively adopted globally in different industries and contexts.

From an *economic* viewpoint, the idealist perspective includes the idea that sustainable innovation and sustainable business models will outpace other alternatives given the superior value propositions to multiple different stakeholders (Schaltegger et al. 2012; Boons and Lüdeke-Freund 2013). This, in turn, leads to system-wide improvements in different facets of global sustainability. In the idealist perspective, even the idea of *degrowth* might be possible in some segments of the economy. Degrowth refers to "equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level, in the short and long term" (Schneider et al. 2010: 511). For instance, Hueting (2010) points out that there is no fundamental conflict between employment and the environment, as "the production and consumption of the same amount of goods require more labour with safeguarding the environment than is required without" (p. 529). Further, it is obvious that less material production is beneficial to ecological systems. However, degrowth in itself is a highly contested issue and stands against many of the mainstream economic practices that rely on rising production and overall gross domestic product (GDP) growth (for discussion, see, e.g., Jackson and Senker 2011; Van den Bergh 2011). Therefore, alternatively, policies and practices could be directed towards growth that is non-resource-consuming (e.g. intangible services and knowledge-based value creation) and therefore, would not contest mainstream economic ideas of the importance of growth. However, in an ideal world, both types of economic development (degrowth and sustainable growth) could take place in different contexts.

In *environmental* terms, the idealist perspective offers the promise of innovation and technological development as a solution to ecological challenges. For instance, Falk and Ryan (2007) argued that moving towards more innovations driven by information and communication technology (ICT) will create more possibilities for smarter production and consumption, and more intangible value creation in general. Other authors expect that the progress in solar and other renewable energy technologies will accelerate to such a pace that these technologies could rapidly replace non-sustainable alternatives, resolving the current energy and environmental crises (see Meneguzzo et al. 2015). The most radical voices expect that technological innovation can even reverse climate change, for example, through carbon dioxide capture technologies (see, e.g., Tokarska and Zickfeld 2015).

Several authors have also advocated the power of business-originating innovation in resolving *social* issues. The concept of "shared value" in particular has been used in arguments that businesses can create economic value by resolving different social problems, including the argument that such models could very well be scalable (see Porter and Kramer 2011). Further, innovation has been seen as a way to reduce global inequality. Famously, Hart and Christensen (2002) advocate "the great leap" and argue that multinational corporations could roll out disruptive innovation in emerging markets that could be sustainable from the outset and empower local populations. Similar suggestions have been discussed with various types of innovation, including microfinance, distributed energy production, and local food production, among others. Finally, the most radical voices expect technological progress to be able to replace human labour, and simultaneously, guarantee wealth for everyone, given the right political choices (Brynjolfsson and McAfee 2014).

Conclusion

Viewing the global economy as a complex adaptive system (Beinhocker 2006) allows a reflective, system-level examination of innovation for sustainability. In this chapter, I discussed the sceptical, pragmatic, and idealist perspectives on how sustainable innovation has been viewed, and what types of system-level implications are involved. The *sceptical perspective* relates to pessimism about businesses and the overall capitalist system to provide enough incentives for SOI. Here, firms' actions follow profits, and often, the trade-offs among economic, environmental, and social issues tend to tilt to the advantage of the first one. The *pragmatic perspective* avoids the normative stances and embraces heterogeneity among the broader system or actors, technologies, and institutions. Local differences in sustainability aspirations and capabilities are huge to begin with, and in a co-evolutionary manner, these differences might easily continue increasing. The pragmatic stance assumes that the progress of sustainable innovation will continue, but the road will be heterogeneous, non-linear, and unpredictable. Finally, the *idealist perspective* leans on the promise of synergetic forces among economic, environmental, and social domains. Mutually reinforcing dynamics of business success of sustainable innovation coupled with supportive policy regimes might enable a "virtuous cycle", and allow to resolve major global challenges.

My own take on this matter is that we need all these perspectives to move forward with innovation for sustainability. Without criticism and scepticism, we lack reflexivity on what is truly sustainable. Without realism, we might end up going overboard with our own assumptions—positive or negative. And without idealism, we might lack entrepreneurial drive and innovative initiatives that lead to progress in the first place. In practice, the future is likely to be increasingly complex, with major regional differences. Ultimately, it is up to business and policy, as well as scholarly inquiry, to combine these perspectives in unlocking the system-level potential of sustainability.

References

Acquier, Aurélien, Thibault Daudigeos, and Jonatan Pinkse. 2017. "Promises and paradoxes of the sharing economy: An organizing framework." *Technological Forecasting and Social Change* 125: 1–10.

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Almeder, Robert. 2007. "Pragmatism and philosophy of science: A critical survey." *International Studies in the Philosophy of Science* 21 (2): 171–95.

Anderson, Jamie, and Niels Billou. 2007. "Serving the world's poor: Innovation at the base of the economic pyramid." *Journal of Business Strategy* 28 (2): 14–21.

Arias-Maldonado, Manuel. 2016. "Nature and the anthropocene: The sense of an ending?" In *Environmental politics and governance in the anthropocene*, edited by P. Pattberg and F. Zelli, 45–60. London: Routledge.

Banerjee, Subhabrata Bobby. 2008. "Corporate social responsibility: The good, the bad and the ugly." *Critical Sociology* 34 (1): 51–79.

Banerjee, Subhabrata Bobby. 2010. "Governing the global corporation: A critical perspective." *Business Ethics Quarterly* 20 (2): 265–74.

Beinhocker, Eric D. 2006. *The origin of wealth: Evolution, complexity, and the radical remaking of economics*. Boston, MA: Harvard Business Press.

Bocken, Nancy M.P., Samuel W. Short, P. Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Brynjolfsson, Eric, and Andrew McAfee. 2014. *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. New York: W. W. Norton.

Crane, Andrew, Guido Palazzo, Laura J. Spence, and Dirk Matten. 2014. "Contesting the value of 'creating shared value'." *California Management Review* 56 (2): 130–53.

Devinney, Timothy M. 2009. "Is the socially responsible corporation a myth? The good, the bad, and the ugly of corporate social responsibility." *The Academy of Management Perspectives* 23 (2): 44–56.

Dosi, Giovanni. 1988. "The nature of the innovative process." In *Technical change and economic theory*, edited by Giovanni Dosi et al., 221–35. London: Pinter.

Falk, Jim, and Chris Ryan. 2007. "Inventing a sustainable future: Australia and the challenge of eco-innovation." *Futures* 39 (2–3): 215–29.

Fonseca, Alberto, Mary Louise McAllister, and Patricia Fitzpatrick. 2014. "Sustainability reporting among mining corporations: A constructive critique of the GRI approach." *Journal of Cleaner Production* 84: 70–83.

Frynas, Jedrzej George. 2005. "The false developmental promise of corporate social responsibility: Evidence from multinational oil companies." *International Affairs* 81 (3): 581–98.

Geels, Frank W. 2010. "Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective." *Research Policy* 39 (4): 495–510.

Gelissen, John. 2007. "Explaining popular support for environmental protection: A multilevel analysis of 50 nations." *Environment and Behavior* 39 (3): 392–415.

Hart, Stuart L., and Clayton M. Christensen. 2002. "The great leap: Driving innovation from the base of the pyramid." *MIT Sloan Management Review* 44 (1): 51.

Hawn, Olga, Aaron K. Chatterji, and Will Mitchell. 2018. "Do investors actually value sustainability? New evidence from investor reactions to the Dow Jones Sustainability Index (DJSI)." *Strategic Management Journal* 39 (4): 949–76.

Hockerts, Kai, and Rolf Wüstenhagen. 2010. "Greening Goliaths versus emerging Davids—Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship." *Journal of Business Venturing* 25 (5): 481–92.

Holland, John H. 1995. *Hidden order: How adaption builds complexity*. Reading, MA: Addison-Wesley.

Hollender, Jeffrey. 2015, April 29. Net positive: The future of sustainable business. *Stanford Social Innovation Review*. https://ssir.org/articles/entry/net_positive_the_future_of_sustainable_business.

Hueting, Roefie. 2010. "Why environmental sustainability can most probably not be attained with growing production." *Journal of Cleaner Production* 18 (6): 525–30.

Husted, Bryan W., and José de Jesus Salazar. 2006. "Taking Friedman seriously: Maximizing profits and social performance." *Journal of Management Studies* 43 (1): 75–91.

Inigo, Edurne A., and Laura Albareda. 2016. "Understanding sustainable innovation as a complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.

Jackson, Tim, and Peter Senker. 2011. "Prosperity without growth: Economics for a finite planet". *Energy & Environment* 22 (7): 1013–16.

Markard, Jochen, Rob Raven, and Bernhard Truffer. 2012. "Sustainability transitions: An emerging field of research and its prospects." *Research Policy* 41 (6): 955–67.

Meneguzzo, Francesco, Rosaria Ciriminna, Lorenzo Albanese, and Mario Pagliaro. 2015. "The great solar boom: A global perspective into the far reaching impact of an unexpected energy revolution." *Energy Science & Engineering* 3 (6): 499–509.

Mitleton-Kelly, Eve. 2003. *Complex systems and evolutionary perspectives on organisations: The application of complexity theory to organisations*. Oxford, UK: Elsevier Science.

Morrison-Saunders, Angus, and Thomas B. Fischer. 2010. "What is wrong with EIA and SEA anyway? A sceptic's perspective on sustainability assessment." In *Tools, techniques and approaches for sustainability: Collected writings in environmental assessment policy and management*, edited by W. R. Sheate, 221–41. Singapore: World Scientific Publishing.

O'Toole, James, and David Vogel. 2011. "Two and a half cheers for conscious capitalism." *California Management Review* 53 (3): 60–76.

Piketty, Thomas. 2014. *Capital in the twenty-first century*. Cambridge, MA: Harvard University Press.

Porter, Michael E., and Mark R. Kramer. 2011. Creating shared value. *Harvard Business Review* 89 (1/2): 62–77.

Prahalad, Coimbatore Krishna. 2012. "Bottom of the pyramid as a source of breakthrough innovations." *Journal of Product Innovation Management* 29 (1): 6–12.

Ritala, Paavo, Pontus Huotari, Nancy Bocken, Laura Albareda, and Kaisu Puumalainen. 2018. "Sustainable business model adoption among S&P 500 firms: A longitudinal content analysis study." *Journal of Cleaner Production* 170: 216–26.

Schaltegger, Stefan, Florian Lüdeke-Freund, and Erik G. Hansen. 2012. "Business cases for sustainability: The role of business model innovation for corporate sustainability." *International Journal of Innovation and Sustainable Development* 6 (2): 95–119.

Schaltegger, Stefan, Florian Lüdeke-Freund, and Erik G. Hansen. 2016. "Business models for sustainability: A co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation." *Organization & Environment* 29 (3): 264–89.

Schneider, François, Giorgos Kallis, and Joan Martinez-Alier. 2010. "Crisis or opportunity? Economic degrowth for social equity and ecological sustainability. Introduction to this special issue." *Journal of Cleaner Production* 18 (6): 511–18.

Shevchenko, Anton, Moren Lévesque, and Mark Pagell. 2016. "Why firms delay reaching true sustainability." *Journal of Management Studies* 53 (5): 911–35.

Stiglitz, Joseph E. 2012. *The price of inequality: How today's divided society endangers our future*. New York: W. W. Norton.

Tang, Zhi, Clyde Eiríkur Hull, and Sandra Rothenberg. 2012. "How corporate social responsibility engagement strategy moderates the CSR–financial performance relationship." *Journal of Management Studies* 49 (7): 1274–303.

Tokarska, Katarzyna B., and Kirsten Zickfeld. 2015. "The effectiveness of net negative carbon dioxide emissions in reversing anthropogenic climate change." *Environmental Research Letters* 10 (9): 094013.

Van den Bergh, Jeroen C.J.M. 2011. "Environment versus growth—A criticism of 'degrowth' and a plea for 'a-growth'." *Ecological Economics* 70 (5): 881–90.

Vogel, David J. 2005. "Is there a market for virtue? The business case for corporate social responsibility." *California Management Review* 47 (4): 19–45.

3

Innovation for Sustainability: Literature Review and Bibliometric Analysis

Laura Albareda and Arash Hajikhani

Introduction

Over the last few decades, a growing number of organizations have embarked on a path in which sustainability has become a core innovation driver (Boons and Wagner 2009; Hart and Milstein 2003; Nidomulu et al. 2009). The growing attention paid to sustainable development, earth system impacts and planetary boundaries (e.g., climate change, natural resource scarcity and pollution) has turned the focus to innovation for sustainability (IfS) (Blowfield et al. 2007) as a means to solve societal and environmental challenges (Tukker 2005) while bring to the markets new sustainable products and services (e.g., renewable energy)

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(Adams et al. 2016; Boons and Lüdeke-Freund 2013; Bocken et al. 2014), fostering system-wide changes (Inigo and Albareda 2016) and transforming economic and industrial systems toward sustainable development (e.g., circular economy) (Gladwin et al. 1995). Many companies are increasingly changing the way they innovate, fostering integrated economic, social and environmental value creation (Elkington 1997; Klewitz and Hansen 2014) and, therefore, enhancing sustainability system transformation (Geels 2010), including new forms of sustainable business models (Bocken et al. 2014).

In this chapter, we focus on the growing literature on IfS over the last two decades (Hansen and Grosse-Dunker 2013). We present a bibliometric literature review to illustrate how complex research in this area has spread across fields of research including innovation management, economics, environmental engineering, environmental sciences and ecology. We expand previous literature reviews (Adams et al. 2016; Bocken et al. 2014; Boons and Lüdeke-Freund 2013; Inigo and Albareda 2016; Nidomulu et al. 2009), providing an in-depth understanding of how IfS research issues and themes are organized in five key goal-oriented discussions. Following a review of the core literature, we propose a bibliometric analysis to study the impact of this literature over time and its dissemination across other academic research fields in the peripheral literature. The core literature includes the initial research on IfS and the seminal concepts, while the peripheral literature includes research that has crossed the original research parameters as well as other broad empirical analyses (Small 1973).

Literature Review: Methods

In the first part of the literature review, we apply an integrative analysis of IfS codifying the main concepts and theories connected to IfS in management, organization and innovation studies and in environmental engineering over the last two decades. We first selected the core literature using a list of keywords,[1] aiming to understand IfS research in business and organizations into core topics. This analysis classifies the literature in five key goal-oriented discussions that frame the main themes studied by researchers: strategic, operational, organizational, collaborative and systemic IfS. This analysis also comes after prior systematic and integrative literature research analysis done by Adams et al. (2016), and Inigo and Albareda (2016). The second part studies the evolution and dissemination of the IfS concept in the broader scientific and academic debate (Glänzel 2015). We conducted a bibliometric data analysis using the Network Analysis Interface for Literature Studies (NAILS)[2] toolkit, designed in August 2015 by a part of our research team (Knutas et al. 2015). The NAILS statistical and Social Network Analysis (SNA) on bibliometric data has been featured in concept emergence and dissemination (Hajikhani 2017) and patent portfolio comparative analyses (Ranaei et al. 2016). We applied a four-step process as follow:

Step 1: We collected a set of keywords with input from a panel of experts to initiate the core literature selection. We constructed our search query with initial keywords and Boolean operators, using the Web of Science (WoS) as a search database.[3] This led to a total of 6324 papers with the full bibliometric data available for further analysis.

Step 2: We refined our initial search, with downloaded bibliometric data bundled by a compression tool to upload into NAILS. As a result, we generated a tailor-made report providing abstract/keyword analyses, productive authors/journals and recommendations on top publications according to citation data. We used the NAILS report in the expired review process. This resulted in 56 core literature pieces (online report: https://goo.gl/ECYcdd).

Step 3: We explored the dissemination of this "core literature" (Small 1973) which included a total of 484 relevant research papers (online report: https://goo.gl/aLwH43). The relevance ratio highlights the importance of the core literature based on the number of citations received. The "times cited per year" variable is another indication of the quality of papers based on the average citations they receive each year.

Step 4: We delineated the perception of core literature by identifying the most relevant peripheral literature in a multidisciplinary field of science. In keeping with Cooper et al. (2009), we studied citation connections to understand the relevance of IfS as a scientific topic of discussion. The NAILS tool calculated new indexes, including the publications' relevance, their dates and research fields. We established the rule for peripheral papers to ensure that they cited a minimum of 3 core literature publications. This served as a proxy to ensure that the papers are moving the core discussions forward.

Business Innovation for Sustainability: Key Discussions

Research on IfS first appeared approximately in 2002 (Hart and Christensen 2002; Hart and Milstein 2003) adopting prior concepts forested by seminal sustainable development documents, the Brundtland Report (WCED 1987) or the triple bottom line (Elkington 1997). We also want to highlight that IfS research is sourced on previous seminal work in business sustainability theory which appeared as of 1995. The key business sustainability theoretical papers proposed a paradigm shift toward organizations and sustainable development (Elkington 1997; Gladwin et al. 1995; Hart 1995; Porter and van der Linde 1995; Shrivastava 1995; Shrivastava and Hart 1995). The main difference between sustainable business and IfS is that the second group of research focus mainly on the integration between sustainability within innovation. Extending previous analyses (Adams et al. 2016; Inigo and Albareda 2016), the results of this literature review codify and classify the literature of IfS into five main discussions: strategic, operational, organizational, collaborative and systemic. These five discussions frame the main topics and goals adopted by management, organization and engineering researchers studying how companies are able to transform their innovation tools, management and goals integrating the principles of sustainable development. This include three main changes: transforming innovation from technical sustainability (e.g., life-cycle analysis) to changing people mind-set (e.g., triple bottom line), changing IfS as stand-alone activity within the company toward a whole strategic and organizational practices and changing the vision of the firm from insular market impacts (e.g., sustainable products and services) to broad societal systemic change (e.g., sustainable business models, circular economy) (Adams et al. 2016).

Strategic IfS

The main discussion in IfS literature encompasses an analysis of its strategic dimensions, primarily related to sustainable value creation (Hart and Christensen 2002; Hart and Milstein 2003; Zollo et al. 2013), and core competences (Chen 2008). Inigo and Albareda (2016) study three different challenges. The first is connected to market orientation and sustainable value creation (Boons and Wagner 2009; Shrivastava 1995) and implies adopting a pathway to build sustainable business models (Bocken et al. 2013; Inigo et al. 2017). This connects IfS to radically different economic, social and environmental value creation processes (Di Domenico et al. 2010; Figge and Hahn 2004), and sustainable business models (Bocken et al. 2014; Stubbs and Cocklin 2008). The second challenge is based on how IfS transforms business strategy, implying new approaches to traditional strategic management and enhancing new forms of business organizing and bottom-of-the-pyramid structures (Prahalad and Hart 2001; Prahalad 2012), social enterprises and hybrid organizing (Dacin et al. 2011) and the changes adopted by firm fostering IfS (Arnold and Hockerts 2011; Schaltegger and Wagner 2011). The third challenge connects IfS to performance and benefits, including economic performance and cost analyses (Bos-Brouwers 2010).

Shared value creation focuses on the interconnections between economic progress and societal challenges by re-conceiving products and markets, redefining productivity in the value chain and enabling local cluster developments (Porter and Kramer 2011). Social innovation goes beyond economic benefits and mainly focuses on innovation as a key tool to solve the most urgent grand challenges (Nicholls and Murdoch 2012). Social innovation connects to social entrepreneurship as a core driver (Hall 2014; Hockerts and Wüstenhagen 2010; McGowan and Westley 2015). Responsible innovation has emerged in the last few decades, emphasizing a mutual and responsible approach among multiple stakeholders participating and affected by innovation; the goal is to anticipate the outcomes and the negative impacts and shared responsibilities (Von Schomberg 2013).

Operational IfS

Operational IfS is the second main discussion. Operational IfS studies how businesses transform operational processes into more eco-efficient procedures (WBCSD 2000). Operational optimization aims to change production systems to integrate new process-oriented knowledge and tools (e.g., eco-efficiency, sustainable life-cycle assessment and environmental management) across the whole value chain (Adams et al. 2016; Carrillo-Hermosilla et al. 2010). Operational IfS involves three main challenges (Inigo and Albareda 2016). The first is ensuring sustainability across the whole life cycle and value chain, adopting waste management, industrial symbiosis and circular economy approaches (Sharma and Iyer 2012). The second is based on product and service design, including eco-innovation and eco-design (Pujari 2006). The third is improving performance, adopting environmental management systems, impact minimization technologies and re-designing processes (Boons et al. 2013; Schaltegger and Burritt 2014).

Research on operational IfS mainly began with eco-efficiency (Ehrenfeld 2005; Hellström 2007; WBCSD 2000), fostering environmental efficient innovation tools and activities to include environmental impacts on company operations (Hansen et al. 2009; Harms et al. 2013). Eco-efficiency is a management approach that encourages businesses to search for environmental improvements that finally lead to integrated ecologic and economic benefits and foster new ways of doing business by integrating environmental and economic value creation (WBCSD 2000: 4). It goes beyond incremental efficiency, transforming operations with new systemic tools and strategies that promote radical and sustainable process innovation, affecting the entire life-cycle assessment across value chains and the industrial and innovation ecosystem (Chertow and Ehrenfeld 2012; Wagner 2008).

All of these changes connect eco-innovation (Del Río 2009), which is framed under different disciplines, technological change, systems analysis and operations research, industrial ecology and industrial economics (Del Río et al. 2010). Eco-innovation aims to change the environmental performance of consumption and production activities (Kemp et al. 2007). Early on in this century, eco-efficiency and eco-innovation have expanded to include: sustainable product innovation (Clark et al. 2009), eco-design

(Dangelico and Pujari 2010) and clean technological changes (Horbach et al. 2012). Operational innovation also fosters sustainable supply chain management, life-cycle analysis (Melville 2010), industrial symbiosis (Mirata and Emtairah 2005) and industrial ecology (Boons et al. 2016).

Organizational IfS

The third discussion is the analysis of organizational transformation enhanced by IfS. Organizational IfS studies how business is changing their organizations, exploring new ways of organizing and managing IfS, as for example whole life-cycle thinking (Inigo and Albareda 2016; Seebode et al. 2012). According to Adams et al. (2016: 10), organizational transformation involves "a fundamental shift in mindset." IfS is embedded in new multidisciplinary practices developed across departments and units, disseminating new strategic approaches and embedding sustainability as a core driver for innovation (e.g., waste to management) (Nidomulu et al. 2009; Sharma 2005). It does so in favor of a systematic organizational ecosystem, fostering leadership and radical IfS (e.g., slow business models) (Inigo et al. 2017).

There are three main challenges (Inigo and Albareda 2016). The first involves the development of new IfS capabilities (Van Kleef and Roome 2007), either promoting new organizational and relational capabilities and attracting new talent or training employees and innovation teams and managers. This also involves developing relational capabilities with external partners. The second challenge is addressing natural resource scarcity, promoting the efficient use of natural resources and innovative waste management, recycling, reusing and remanufacturing and creating value from waste. This strategy serves to innovate and create new value or promote new creativity or bricolage in scarce resource environments, fostering inclusive businesses (Halme and Korpela 2014). The third challenge involves new forms of organizing, including a shift in organizational mind-sets and in how to do business and innovate by creating shared value, integrating IfS into the companies' culture and goals and thereby accelerating IfS (Jay and Gerard 2015). Compared to traditional technological and market-pull innovation, IfS is different because it requires a higher level of inter-organizational knowledge generation to address social and environmental challenges and intra-organizational dialogue and co-creation with societal and environmental stakeholders (Castiaux 2012; Rennings 2000). These capabilities include developing a system-wide view of the innovation process and learning and experimenting (Van Kleef and Roome 2007).

Collaborative IfS

The fourth core discussion is based on IfS' collaborative nature with different societal and environmental partners and stakeholders (Nidomulu et al. 2009). IfS requires multiple partnerships and collaborative alliances between the company and technological partners but also with social and environmental stakeholders (De Marchi 2012; Goodman et al. 2017). Successful IfS becomes increasingly collaborative (Ghisseti et al. 2015). Furthermore, social and environmental stakeholders become key partners (Ayuso et al. 2011) through the adoption of new platforms and knowledge sources to stimulate creativity and overcome sustainability challenges (Ayuso et al. 2006). IfS also includes different dynamics such as design-thinking and co-creation workshops (Senge et al. 2008), root innovation (McGowan and Westley 2015), stakeholder dialogue (Ayuso et al. 2006), value-mapping (Bocken et al. 2013), supplier co-creation, user-focus innovation, societal co-creation (Hansen and Spitzeck 2011), social bricolage (Di Domenico et al. 2010), sustainable business models (Richter 2013) and reverse innovation (Govindarajan and Ramamurti 2011).

In this sense, collaborative IfS connects to three main challenges (Inigo and Albareda 2016). The first is to respond to public policies and new regulations (Horbach et al. 2012). The second is connected to how companies participate and co-create with local IfS networks and clusters, including industrial symbiosis (Paquin and Howard-Greenville 2012) and circular economy initiatives (Geissdoefer et al. 2017). The third challenge connects IfS to open innovation and how to build new partnerships (Ghisseti et al. 2015; Senge et al. 2008), including with new R&D partners and research centers (Chen and Hung 2014).

Systemic IfS

Finally, IfS literature connects to sustainable systems transformation (Adams et al. 2016; Loorbach et al. 2010). IfS aims to transform the industrial and capitalist economy toward sustainable development systems (Nill and Kemp 2009; Tukker et al. 2008). An example is a bottom-of-the-pyramid as a social enterprise (Prahalad and Hart 2001) that creates new opportunities for the poorest socioeconomic groups in both developing and developed countries. This implies emergent paradigms of social enterprises (Dacin et al. 2010) that take IfS as a core driver for sustainable change (Stubbs and Cocklin 2008) as well as sufficiency-driven business models (Bocken and Short 2015). There are three main challenges (Inigo and Albareda 2016). The first is based on how IfS helps to implement the system-level transition (Boons and Wagner 2009; Chertow and Ehrenfeld 2012; Geels 2011). The second involves transforming production and consumption dimensions (Hall 2002). The third challenge connects to the discussion on the emergence of sustainable enterprise organizing (Di Domenico et al. 2010; Hart 2012).

Bibliometric Analysis

In this section, we investigate the five discussions within core IfS publications over the years, their dissemination and citations, their time-evolving impact in other fields of research in the peripheral literature. We also analyze sustainable business theory as a main source for the dissemination of IfS literature.

Time-Evolving Impact

Since 1995, the scientific discussion on sustainable business theory has influenced the growing volume of IfS research (WCED 1987; Elkington 1997). IfS literature has grown considerably and quickly since 2002 (Hart and Milstein 2003). By studying the literature on IfS, we have detected the core literature and, accordingly, the peripheral literature. We study the time-evolving impacts of the core literature within the five

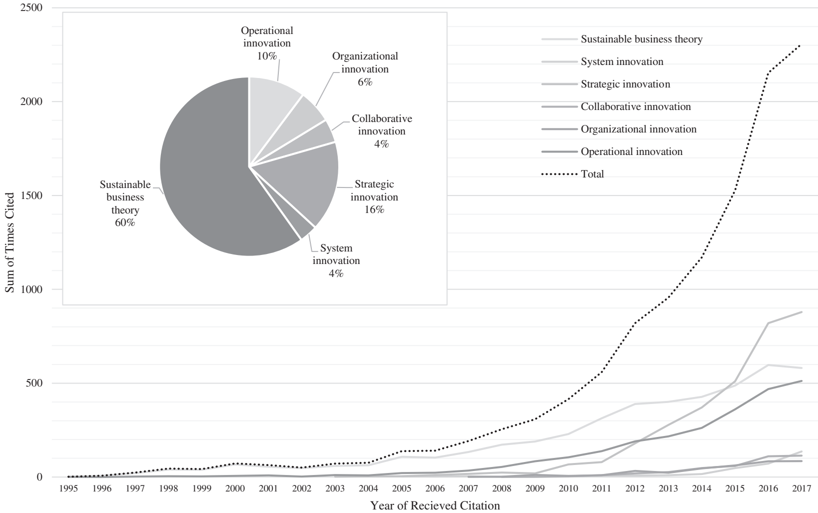

Fig. 3.1 Core literature citations received for the 5 key IfS discussions over time

discussion categories detailed above and show how it has expanded over time (see Fig. 3.1).

Core literature: Fig. 3.1 clearly indicates that the total citations received by the core literature in the five key IfS discussions have grown exponentially, featuring a sharper increase since 2006. Our research illustrates how papers on sustainable business theory achieving a 60% impact based on citations. Regarding the five main IfS discussions, the strategic and operational discussions are driving 26% of the impact and dissemination. The strategic IfS discussion is the most important. It includes the main seminal papers on strategy and IfS, sustainability and value creation and proposes the main concepts such as sustainable value creation, sustainable entrepreneurship and the bottom-of-the-pyramid approach. Operational IfS is also very important as it includes broad research on eco-efficiency, eco-innovation and life-cycle analysis, including the main empirical papers. Organizational and collaborative IfS discussions started later and have become more accepted within the academic community much more recently. Consequently, their impact through citations is smaller. Organizational IfS has recently had greater impact due to the growing volume of new research on organizational capabilities and different types of organizational transformations. Collaborative IfS has also grown considerably over the last few years due to the increasing attention to new forms of co-creation and collaboration between companies and social and environmental partners, open innovation and partnerships. Finally, systemic IfS is the newest discussion based on an analysis of sustainability transitions and societal changes.

Peripheral literature: Fig. 3.2 indicates the number of publications in both core and peripheral literature over time. Since we had the core literature discussions as identified by experts (56 papers), we were able to extract the papers which cited the core literature, referring to these as peripheral (almost 7000 papers).

The analysis of the literature ended with 425 peripheral papers. Our results clearly indicate that the major discussions on IfS in the "core literature" category have emerged in the past 15 years with a significant increase since 2010. The periphery has also been inspired, with a significant increase in publications as of 2010.

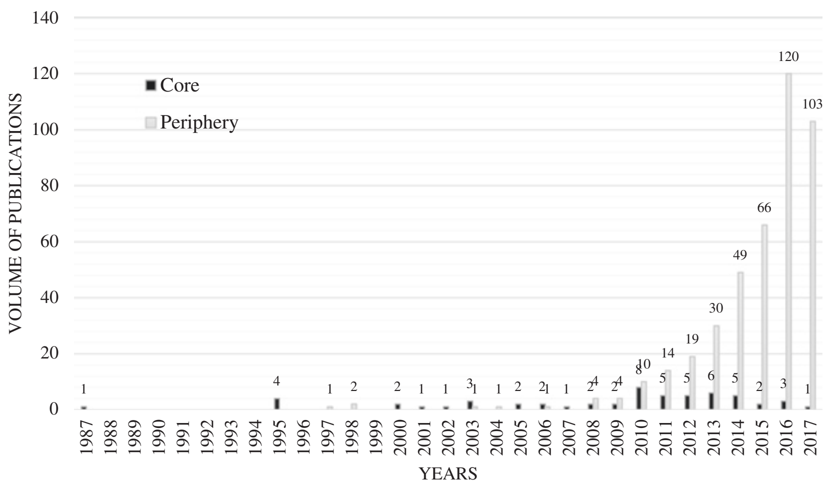

Fig. 3.2 Time series for core and peripheral literature publication numbers

Fields of Research Dissemination

We also measured the impact and influence of IfS through its dissemination in other fields. We calculated the accumulated citations of each article in both the core and peripheral literature and tabulated them for the subject categories. Figure 3.3 represents the impact of the categories studied in core and peripheral literature by citation points. It is clear that, while there is an obvious overlap of the subject categories among core and peripheral literature, we can see a shift in subject categories. The peripheral literature shows a significant appreciation for new subjects such as "Environmental studies, Management" and "Economics, engineering, civil." It is interesting to note that, while topics such as "Economics," "Management, planning & development" and "Industrial engineering" in the core literature were highly cited, the peripheral literature hasn't received the same attention citation-wise yet. However, on subject categories such as "Green & Sustainable science & technology," "Management," "Environmental studies, management" and "Business,"

Fig. 3.3 Distribution of subject category citations in the core and peripheral literature

the peripheral literature shows an increase of appreciation via citation points compared to the core literature. Meanwhile, it is important to note that the peripheral literature has spread the notions of sustainability and innovation to areas such as psychology, agriculture, hospitality and forestry, a fact also recognized by the number of citations.

The top portion of Fig. 3.4 shows the frequency of the most popular publication venues (quantity of times which the venue publishes a paper) and popular ones (sorted by the number of received citations) for the IfS core literature. In addition, the bottom part of Fig. 3.4 illustrates the most popular and most cited venues for the peripheral publications.

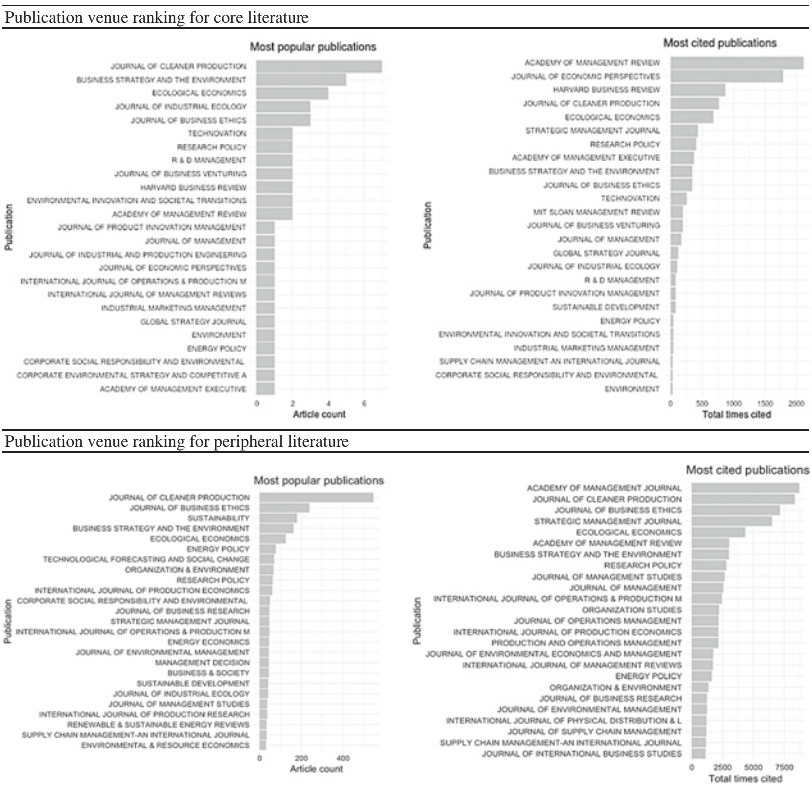

Fig. 3.4 Most popular and cited publication venues for core and peripheral literature

The most popular publication venues for the core literature include *Journal of Cleaner Production*, *Business Strategy and Environment*, and *Ecological Economies*, while the most cited publications are *Academy of Management Review*, *Journal of Economic Perspectives*, and *Harvard Business Review*. For the peripheral literature, the most popular publications are *Journal of Cleaner Production*, *Journal of Business Ethics*, and *Sustainability*, while the top cited publication is *Academy of Management Journal*, *Journal of Cleaner Production* and *Journal of Business Ethics*.

Conclusion

We have presented a bibliometric study that explores how IfS literature has grown and developed over the last two decades. The main conclusion is that IfS core literature mainly comprises five key goal-oriented discussions: strategic, operational, organizational, collaborative and systemic IfS changes that frame the main topics and themes that researchers study to understand the main transformations undergone by businesses and organizations to embrace sustainable development principles and systems-based transformation (Geels 2010). The literature analysis is based on previous research (Adams et al. 2016; Bocken et al. 2014; Boons and Lüdeke-Freund 2013; Inigo and Albareda 2016; Nidomulu et al. 2009), providing an in-depth understanding of how IfS research issues and themes are organized. This bibliometric analysis shows the differences on impact and citation between different discussions. IfS literature is strong on strategic and operational themes that have been the two most impactful since 2002, including the main papers and theoretical and conceptual references in IfS. Contrarily, organizational, collaborative and systemic IfS discussions have emerged and increased in the last few years. This is mainly due to the current changes adopted by leading companies in IfS (e.g., Patagonia, Unilever) with growing collaboration between companies and social and environmental partners to build sustainable business models (e.g., slow fashion, waste to management, social innovation), in addition to sustainability transitions and societal change. In terms of the core literature, the two key fields of research are business management and economics followed by environmental sciences and environmental studies. This responds to the sources of IfS research on strategic and innovation management. The main fields of research for the peripheral literature show greater impact and interconnections with environmental studies, management and economics and civil engineering. Thus, we see a clear dissemination and interactions from business management toward more applied research in which the main IfS theories and ideas can be applied with empirical studies and real practices adopted by companies. In this sense, managers are embracing operational IfS changes, while exploring new sustainable business models, and co-creating new sustainable products and services (e.g., organic food, renewable energy, clean technologies). Managers and entrepreneurs can use these five-oriented goals of IfS to understand how to apply IfS goals into real practices. IfS literature analysis shows a road-map for managers to adopt new practices and strategies connected to strategic changes (sustainable business models, shared value, slow production, circular economy), operational optimization (eco-innovation, eco-efficiency, whole life-cycle analysis, clean technologies), organizational changes (social innovation, complex adaptive systems), collaborative pathways (with social and environmental stakeholders), and finally, system-change toward a new way to design and adopt production and consumption systems (e.g., circular economy). Beyond that, researchers and managers should work hand in hand to make IfS real and mainstream as a new way to do and integrate sustainability, innovation and value creation.

Notes

1. Sustainability-oriented innovation, sustainable innovation, sustainability and innovation, innovation for sustainable development, social innovation, responsible innovation, green and eco-innovation.
2. http://nailsproject.net/ online interface.
3. WoS is maintained by Thomson Reuters and has 90 million documents indexed. It is considered one of the most important databases for scientific bibliometric data.

References

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Arnold, Marlene Gabrielle, and Kay Hockerts. 2011. "The greening Dutchman: Phillips' process of green flagging to drive sustainable innovation." *Business Strategy and the Environment* 20 (6): 394–407.

Ayuso, Silvia, Miguel Ángel Rodríguez, and Joan Enric Ricart. 2006. "Using stakeholder dialogue as a source for new ideas: A dynamic capability underlying sustainable innovation." *Corporate Governance: International Journal of Business and Society* 6 (4): 475–90.

Ayuso, Silvia, Miguel Ángel Rodríguez, Roberto García-Castro, and Miguel Ángel Ariño. 2011. "Does stakeholder engagement promote sustainable innovation orientation?" *Industrial Management & Data Systems* 11 (9): 1399–417.

Blowfield, Mick, Wayne Visser, and Finbarr Livesey. 2007. "Sustainability innovation: Mapping the territory." University of Cambridge Programme for Industry Research Paper Series, n. 2.

Bocken, Nancy, and Samuel Short. 2015. "Towards a sufficiency-driven business model: Experiences and opportunities." *Environmental Innovation and Societal Transitions* 18: 41–61.

Bocken, Nancy, Samuel Short, Padmaski Rana, and Steve Evans. 2013. "A value mapping tool for sustainable business modelling." *Corporate Governance: An International Review* 13 (5): 482–97.

Bocken, Nancy, Samuel Short, Padmaski Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, Carlos Montalvo, Jaco Quist, and Marcus Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 1–8.

Boons, Frank, and Marcus Wagner. 2009. "Assessing the relationship between economic and ecological performance: Distinguishing system levels and the role of innovation." *Ecological Economics* 68 (7): 1908–14.

Boons, Frank, Marian Chertow, Jooyoung Park, Wouter Spekkink, and Han Shi. 2016. "Industrial symbiosis dynamics and the problem of equivalence:

Proposal for a comparative framework." *Journal of Industrial Ecology* 21 (4): 938–52.

Bos-Brouwers, Hilke Elke Jake. 2010. "Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice." *Business Strategy and the Environment* 19: 417–35.

Carrillo-Hermosilla, Javier, Pablo Del Río, and Totti Könnölä. 2010. "Diversity of eco-innovations: Reflections from selected case studies." *Journal of Cleaner Production* 18: 1073–83.

Castiaux, Annick. 2012. "Developing dynamic capabilities to meet sustainable development challenges." *International Journal of Innovation Management* 16 (6): 1240013.

Chen, Yu-Shan. 2008. "The driver of green innovation and green image—Green core competence." *Journal of Business Ethics* 81 (3): 531–43.

Chen, Ping-Chuan, and Shiu Wan Hung. 2014. "Collaborative green innovation in emerging countries: A social capital perspective." *International Journal of Operations and Production Management* 34 (3): 347–63.

Chertow, Marian, and John Ehrenfeld. 2012. "Organizing self-organizing systems: Toward a theory of industrial symbiosis." *Journal of Industrial Ecology* 16: 13–27.

Clark, Garrette, Justin Kosoris, Long Nguyen Hong, and Marcel Crul. 2009. "Design for sustainability: Current trends in sustainable product design and development." *Sustainability* 1 (3): 409–24.

Cooper, Harris, Larry V. Hedges, and Jeffrey C. Valentine. 2009. *The handbook of research synthesis and meta-analysis*. New York: Russell Sage Foundation.

Dacin, Peter A., Tina M. Dacin, and Margaret Matear. 2010. "Social entrepreneurship: Why we don't need a new theory and how we move forward from here." *Academy of Management Perspectives* 24: 37–57.

Dacin, M. Tina, Peter A. Dacin, and Paul Tracey. 2011. "Social entrepreneurship: A critique and future directions." *Organization Science* 22: 1203–13.

Dangelico, Rosa Maria, and Devashish Pujari. 2010. "Mainstreaming green product innovation: Why and how companies integrate environmental sustainability." *Journal of Business Ethics* 95 (3): 471–86.

De Marchi, Valentina. 2012. "Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms." *Research Policy* 41 (3): 614–23.

Del Río, Pablo. 2009. "The empirical analysis of the determinants for environmental technological change: A research agenda." *Ecological Economics* 68 (3): 861–78.

Del Río, Pablo, Javier Carrillo-Hermosilla, and Totti Könnölä. 2010. "Policy strategies to promote eco-innovation." *Journal of Industrial Ecology* 14 (4): 541–57.

Di Domenico, Maria Laura, Helen Haugh, and Paul Tracey. 2010. "Social bricolage: Theorizing social value creation in social enterprises." *Entrepreneurship Theory and Practice* 34: 681–703.

Ehrenfeld, John. 2005. "Eco-efficiency: Philosophy, theory and tools." *Journal of Industrial Ecology* 9 (4): 6–8.

Elkington, John. 1997. *Cannibals with forks: The triple bottom line of 21st century business*. Oxford: Capstone.

Figge, Frank, and Tobias Hahn. 2004. "Sustainable value added-measuring corporate contributions to sustainability beyond eco-efficiency." *Ecological Economics* 48: 173–87.

Geels, Frank W. 2010. "Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective." *Research Policy* 39 (4): 495–510.

Geels, Frank W. 2011. "The multi-level perspective on sustainability transitions: Responses to seven criticisms." *Environmental Innovation and Societal Transitions* 1 (1): 24–40.

Geissdoefer, Martin, Paulo Saveget, Nancy Bocken, and Erik Jan Hultink. 2017. "The circular economy—A new sustainability paradigm?" *Journal of Cleaner Production* 143: 757–68.

Ghisseti, Claudia, Alberto Marzucchi, and Sandro Montresor. 2015. "The open eco-innovation model: An empirical investigation of eleven European countries." *Research Policy* 44 (5): 1080–93.

Gladwin, Thomas N., James J. Kennelly, and Tara-Shelomith Krause. 1995. "Shifting paradigms for sustainable development: Implications for management theory and research." *Academy of Management Review* 20 (4): 874–907.

Glänzel, Wolfgang. 2015. "Bibliometrics-aided retrieval: Where information retrieval meets scientometrics." *Scientometrics* 102 (3): 2215–22.

Goodman, Jennifer, Angelina Korsunova, and Minna Halme. 2017. "Our collaborative future: Activities and roles of stakeholders in sustainability-oriented innovation." *Business Strategy and the environment* 26 (6): 731–53.

Govindarajan, Vijay, and Ravi Ramamurti. 2011. "Reverse innovation, emerging markets, and global strategy." *Global Strategy Journal* 1 (3–4): 191–205.

Hajikhani, Arash. 2017. "Emergence and dissemination of ecosystem concept in innovation studies: A systematic literature review study." In *Proceedings of the 50th Hawaii International Conference on System Sciences*.

Hall, Jeremy. 2002. "Sustainable development innovation; a research agenda for the next 10 years." *Journal of Cleaner Production* 51: 277–88.

Hall, Jeremy. 2014. "Innovation and entrepreneurial dynamics in the base of the pyramid." *Technovation* 34 (5–6): 265–269.

Halme, Minna, and Maria Korpela. 2014. "Responsible innovation toward sustainable development in small and medium-sized enterprises: A resource perspective." *Business Strategy and the Environment* 23 (8): 547–66.

Hansen, Erik Gunnar, and Friedrich Grosse-Dunker. 2013. "Sustainable innovation." In *Encyclopedia of corporate social responsibility*, edited by S. O. Idowu, N. Capaldi, and A. Das Gupta. New York and Heidelberg: Springer.

Hansen, Erik Gunnar, Friedrich Grosse-Dunker, and Ralf Reichwald. 2009. "Sustainability innovation cube—A framework to evaluate sustainability-oriented innovation." *International Journal of Innovation Management* 13 (4): 683–713.

Hansen, Erik Gunnar, and Heiko Spitzeck. 2011. "Measuring the impacts of NGO partnerships: The corporate and societal benefits of community involvement." *Corporate Governance* 11 (4): 415–26.

Harms, Dorli, Hansen, Erik Gunnar, and Stefan Schaltegger. 2013. "Strategies in sustainable supply chain management: An empirical investigation of large German companies." *Corporate Social Responsibility and Environmental Management* 20 (4): 205–18.

Hart, Stuart L. 1995. "A natural-resource based view of the firm." *Academy of Management Review* 20 (4): 986–1014.

Hart, Stuart L. 2012. "The third-generation corporation." In *Oxford handbook of business and the environment*, edited by P. Bansal and A. J. Hoffman. New York: Oxford University Press.

Hart, Stuart L., and Clayton M. Christensen. 2002. "The great leap: Driving innovation from the base of the pyramid." *MIT Sloan Management Review* 44: 51–56.

Hart, Stuart L., and Mark B. Milstein. 2003. "Creating sustainable value." *Academy of Management Executive* 17 (2): 56–67.

Hellström, T. 2007. "Dimensions of environmentally sustainable innovation: The structure of eco-innovation concepts." *Sustainable Development* 15 (3): 148–59.

Hockerts, Kay, and Wüstenhagen, R. 2010. "Greening Goliaths versus emerging Davids—Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship." *Journal of Business Venturing* 25 (5): 481–92.

Horbach, Jens. 2008. "Determinants of environmental innovation–New evidence from German panel data sources." *Research Policy* 37 (1): 163–173.

Horbach, Jens, Christian Rammer, and Klaus Renning. 2012. "Determinants of eco-innovations by type of environmental impacts—The role of regulatory push/pull, technology push and market pull." *Ecological Economics* 78: 112–22.

Inigo, Edurne, and Laura Albareda. 2016. "Understanding sustainable innovation as a complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.

Inigo, Edurne, Laura Albareda, and Paavo Ritala. 2017. "Business model innovation for sustainability: Exploring evolutionary and radical approaches through dynamic capabilities." *Industry and Innovation* 24 (5): 515–42.

Jay, Jason, and Marine Gerard. 2015. "Accelerating the theory and practice of sustainability-oriented innovation." MIT Sloan Research Paper No. 5148–15. Cambridge, MA: MIT Sloan School.

Kemp, Rene, Derk Loorbach, and Jan Rotmans. 2007. "Transition management as a model for managing processes of co-evolution." *International Journal of Sustainable Development and World Ecology* 14 (1): 78–91.

Klewitz, Johana, and Erik Gunnar Hansen. 2014. "Sustainability-oriented innovation of SMEs: A systematic review." *Journal of Cleaner Production* 65: 57–75.

Knutas, Anti, Arash Hajikhani, Juho Salminen, Jouni Ikonen, and Jari Porras. 2015. "Cloud-based bibliometric analysis service for systematic mapping studies." *Proceedings of the 16th International Conference on Computer Systems and Technologies* 1008: 184–91. https://doi.org/10.1145/2812428.2812442.

Loorbach, Derk, Janneke Van Bakel, Gail Whiteman, and Jans Rotmans. 2010. "Business strategies for transitions towards sustainable systems." *Business Strategy and the Environment* 19: 133–46.

McGowan, Katharine, and Francis Westley. 2015. "At the root of change: The history of social innovation." In *New frontiers in social innovation research*, edited by A. Nicholls, J. Simon, M. Gabriel, and C. Whelan. Basingstoke: Palgrave Macmillan.

Melville, Nigel. 2010. "Information systems innovation for environmental sustainability." *MIS Quarterly* 34 (1): 1–21.

Mirata, Murat, and Tareq Emtairah. 2005. "Industrial symbiosis networks and the contribution to environmental innovation—The case of the Landskrona industrial symbiosis programme." *Journal of Cleaner Production* 13 (10–11): 993–1002.

Nicholls, Alex, and Alex Murdoch. 2012. "The nature of social innovation." In *Social innovation*, edited by A. Nicholls and A. Murdoch. Basingstoke: Palgrave Macmillan.

Nidumolu, Ram, Coimbatore Krishnarao Prahalad, and M. R. Rangaswami. 2009. "Why sustainability is now a key driver of innovation." *Harvard Business Review* 87 (September): 57–64.

Nill, Jan, and Rene Kemp. 2009. "Evolutionary approaches for sustainable innovation policies: From niche to paradigm?" *Research Policy* 38 (4): 668–80.

Paquin, Raymond, and Jennifer Howard-Grenville. 2012. "The evolution of facilitated industrial symbiosis." *Journal of Industrial Ecology* 16 (1): 83–93.

Porter, Michael E., and Class van der Linde. 1995. "Towards a new conception of the environment-competitiveness relationship." *Journal of Economic Perspectives* 9 (4): 97–118.

Porter, Michael E., and Mark Kramer. 2011. "Creating shared value." *Harvard Business Review* 89 (½): 62–77.

Prahalad, Coimbatore Krishnarao. 2012. "Bottom of the pyramid as a source of breakthrough innovations." *Journal of Product Innovation Management* 29 (1): 6–12.

Prahalad, Coimbatore Krishnarao, and Stuart L. Hart. 2001. "The fortune at the bottom of the pyramid." *Strategy and Business* 26: 54–67.

Pujari, Devashish. 2006. "Eco-innovation and new product development: Understanding the influences on market performance." *Technovation* 26 (1): 76–85.

Ranaei, Samira, Antti Knutas, Juho Salminen, and Arash Hajikhani. 2016. "Cloud-based patent and paper analysis tool for comparative analysis of research." *CompSysTech* June: 315–22.

Rennings, Klaus. 2000. "Redefining innovation—Eco-innovation research and the contribution from ecological economics." *Ecological Economics* 32 (2): 319–32.

Richter, Mario. 2013. "Business model innovation for sustainable energy: German utilities and renewable energy." *Energy Policy* 62: 1226–37.

Schaltegger, Stefan, and Marcus Wagner. 2011. "Sustainable entrepreneurship and sustainability innovation: Categories and interactions." *Business Strategy and the Environment* 20 (4): 222–37.

Schaltegger, Stefan, and Roger Burritt. 2014. "Measuring and managing sustainability performance of supply chains." *Supply Chain Management* 19 (3): 232–41.

Seebode, Dorothea, Sally Jeanrenaud, and John Bessant. 2012. "Managing innovation for sustainability." *R&D Management* 42: 195–206.

Senge, Peter M., Brian Smith, Sara Schley, Joe Laur, and Nina Kruschwitz. 2008. *The necessary revolution: How individuals and organizations are working together to create a sustainable world*. New York: Doubleday.

Sharma, Arun, and Gopalkrishnan R. Iyer. 2012. "Resource-constrained product development: Implications for green marketing and green supply chains." *Industrial Marketing Management* 41 (4): 599–608.

Sharma, Sanjay. 2005. "Through the lens of managerial interpretations: Stakeholder engagement, organizational knowledge and innovation." In *Corporate environmental strategy and competitive*, edited by S. Sharma and A. Aragón-Correa. Northampton: Edward Elgar Academic.

Shrivastava, Paul. 1995. "Environmental technologies and competitive advantage." *Strategic Management Journal* 16 (S1): 183–200.

Shrivastava, Paul, and Stuart L. Hart. 1995. "Creating sustainable corporations." *Business Strategy and the Environment* 4: 154–65.

Small, Henry. 1973. "Cocitation in scientific literature—New measure of relationship between 2 documents." *Journal of the American Society for Information Science* 24 (4): 265–69.

Stubbs, Wendy, and Chris Cocklin. 2008. "Conceptualizing a sustainability business model." *Organization & Environment* 21: 103–27.

Tukker, Arnold. 2005. "Leapfrogging into the future: Developing for sustainability." *International Journal of Innovation and Sustainable Development* 1 (1–2): 65–84.

Tukker, Arnold, Martin Charter, Carlo Vezzoli, Eivind Sto, and Maj Much Andersen. 2008. *System innovation for sustainability: Perspectives on radical changes to sustainable consumption and production.* Sheffield, UK: Greenleaf.

Van Kleef, Jans A. G., and Nigel Roome. 2007. "Developing capabilities and competence for sustainable business management as innovation: A research agenda." *Journal of Cleaner Production* 15 (1): 38–51.

Von Schomberg, Rene. 2013. "A vision of responsible innovation." In *Responsible innovation: Managing the Responsible Emergence of Science and Innovation in Society*, edited by R. Owen, J. Bessant, and M. Heintz. Chichester: Wiley.

Wagner, Marcus. 2008. "Empirical influence of environmental management on innovation: Evidence from Europe." *Ecological Economics* 66 (2–3): 392–402.

World Business Council for Sustainable Development (WBCSD). 2000. *Eco-efficiency: Creating more with less*. Geneva: WBCSD.
World Commission on Environment and Development (WCED). 1987. *Our common future*. New York: Oxford University Press.
Zollo, Maurizio, Carmelo Cennamo, and Kerstin Neumann. 2013. "Beyond what and why: Understanding organizational evolution towards sustainable enterprise models." *Organization & Environment* 26 (3): 241–59.

4

Environmental Factors in Business Engagement in Innovation for Sustainability

Edurne A. Inigo

Introduction

From the publication of the ‘Our Common Future’ by the Commission headed by Gro Harlem Brundtland (WCED 1987), to the operationalisation of the Sustainable Development Goals—SDGs, onwards—(United Nations, G. A. 2015), the quest for social, environmental and economic sustainability has been on the global agenda. Leading businesses worldwide have directed their efforts towards the development of new products, processes and business models that minimise harm to the environment, improve social welfare and sustain economic growth while creating value for the firm. Innovation has proven to be one of the most effective strategies of businesses to contribute to such sustainability goals (European Commission 2012; OECD 2010); nevertheless, introducing environmental and social

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goals in the innovation process brings in added complexity (Hansen et al. 2009) that must be overcome different levels of the firm: organisational, strategic, operational, technological, societal. In addition, external factors sway businesses' innovation for sustainability (IfS) efforts in a certain direction (Maletič et al. 2018). These external factors are created by the social, environmental and economic trends occurring in the corporate field, such as changes in legislation or consumer preferences, as well as more disruptive events that cause a major impact on the whole system, such a technological breakthrough or an environmental disaster.

This considered this chapter looks at IfS and how environmental factors affect businesses in their development, showing that change is driven not only from within, but also from the outside. Because of this, companies embarking in the IfS journey must keep an inward- and outward-looking attitude (Dangelico et al. 2013), learning to manage and adapt to a changing environment in order to thrive. Therefore, we will examine the different degrees to which environmental factors influence the IfS journey, and how companies adapt and themselves contribute to systems change through their engagement in IfS.

Background

Innovation for sustainability, that is, *innovation that aims to create not only economic but also environmental and social value* (Adams et al. 2016) has become a cornerstone of the business sustainable development strategy (Jay and Gerand 2015). Decoupling environmental degradation and social erosion from economic growth is now a major goal in the global agenda (UNEP 2011), and, as major actors of innovation, businesses have shown great ability to perform as levers in the transformation towards sustainability (Inigo and Albareda 2016). IfS is not solely concerned with the consecution of social and environmental goals: the importance of innovation driven by sustainability to improve competitiveness has been noted by scholars and businesses (Nidumolu et al. 2009; Pfitzer et al. 2013).

The concern about the role of businesses in sustainability and how they could act as agents of change through innovation came hand in hand with the rise of ecological economics as a discipline, and the publication of the report *Limits to Growth* by the Club of Rome (Meadows et al. 1972). This report drew on the systems thinking methodology (Forrester 1968) and previous economic research (e.g. Boulding 1966) to point at the environmental thresholds and material balance rules of the environment that the economic system was breaking in the name of growth. These models show how the economic system and its main actors, businesses, are embedded in a social system which is, in turn, embedded in the natural system.

These developments attracted the attention of management scholars, who saw innovation as a manner to improve the impact of business on the social and environmental systems without compromising economic development (Adams et al. 2016; Hansen et al. 2009). Initially, eco-innovation was the major point of interest, concentrating on how to develop products and processes that reduced environmental impacts (Fussler and James 1996). In fact, the first steps carried out by businesses in this regard were indeed so-called end-of-pipe solutions, which reduced harm to the environment without changing strategy substantially. Social innovation or those '*innovative activities and services that are motivated by the goal of meeting a social need*' also gained attention (Mulgan et al. 2007: 8), however very often in non-competitive contexts. However, IfS goes beyond environmental and social innovation by integrating economic, social and ecological concerns (Schiederig et al. 2012). It also becomes aligned with business strategy, as a tool to enhance economic, social and environmental performance of the firm (Bos-Brouwers 2010; Jay and Gerand 2015).

These strategies come as a response of companies to environmental factors to which the need to adapt. These changes may come from the demand from consumers for sustainable products, citizen response to environmental disasters or from the diminishing stock of certain raw materials to name a few. For example, the first movements in IfS were mostly concerned with products and processes, with a strong focus on material and energy efficiency and the reduction of harmful emissions. This came as a response to environmental disasters at rather local levels, such as oil spills or the emission of pollutants in rivers.

However, environmental factors evolve, showing a wider interconnection between business, society and the environment than the immediate response to market demands of public turmoil over a particular issue. Both practitioners and scholars came to the realisation that, on top of management practices that included such goals, for them to be effective, a connection with its wider system was needed. This was prompted by the emergence of global social and environmental problems, such as modern slavery or climate change. The need to find a new role for business in society has resulted in a wider trend on business model innovations for sustainability (Bocken et al. 2014; Lüdeke-Freund et al. 2016; Stubbs and Cocklin 2008). The aim is to connect the different aspects of sustainable value creation and capture, beyond technology development. Moreover, IfS has started to be directed towards the realisation of global objectives, such as the SDGs, or towards the engrailment of business innovation in a wider sustainability-oriented system, such as the circular economy (Geissdoerfer et al. 2017).

In this regard, the example set by Philips' journey of IfS is illustrative (Seebode et al. 2012). At the beginning, the company was mostly concerned with increasing the efficiency of their light bulbs, so that the consumption of energy would be lowered. This responded to customer demands for more efficient products. Then, the company was concerned with materials use and started to work on increasing the durability of light bulbs, so that less materials were used for the same period of lighting, due to the pressing concerns over the obsolesce of light bulbs. However, reduced energy consumption and the need to buy less bulbs over time lead to an unexpected consequence: more lighting is used, including new uses for lighting as ornament, for example (Franceschini et al. 2018). In addition, despite the increased durability of their products, there was no control of recyclable or reusable materials after use. Therefore, Philips designed a new strategy, framed under circular economy principles: selling light as a service instead of light bulbs (Philips 2018; Seebode et al. 2012). In this way, the company can ensure the optimal efficiency of lights at location, while being able to take control of materials and work with the repair, reuse and recycle principles of the circular economy. Not only is this system beneficial from a sustainability perspective, it also avoids upfront costs for the consumer—which can be large for office space and public buildings—and ensures a steady cash flow for the company. The IfS engagement journey of Philips shows how it was not derived from internal decisions only—the external environmental guided the transition as well. The following sections will look at how environmental factors and how companies manage them affect the successful engagement in IfS.

Efforts to improve the sustainability of the economic system, linked to the literature and practice in industrial ecology that had been flourishing in the previous decades (Murray et al. 2017), have led researchers and practitioners alike towards the theory of socio-technical systems transitions for sustainability, which approaches IfS from a systemic perspective, as a lever for wider change. Socio-technical transitions theory for sustainability examines how innovations developed at a niche level gradually change the pre-existing cultural, market, policy, technological and industrial regime, while, in turn, the development of such innovations is affected by such regime dynamics, as well as landscape conditions (Geels and Schot 2007). For businesses, the effect of this perspective is twofold: first, when they are part of the regime for a particular innovation, they will be pushed into a certain direction; but second, they are also able to shape the environment in which they operate by developing and diffusing innovations. The focus of analysis in this corpus of research is the change in wider socio-ecological system, although the role of businesses in these transitions has also been explored (Loorbach and Wijsman 2013).

Acknowledging the embeddedness of businesses in a wider system and their capacity to act as agents of change also means realising that the boundaries of the firm are permeable; therefore, IfS activities will also be influenced by the external environment (Keskin et al. 2013). When research has looked at environmental circumstances for IfS, it has often done so without looking directly at how it affected organisational transformation of business as actors in sustainability transitions (Bergek and Berggren 2014) or as an exploration of the actors and relationships in innovation systems for sustainability and collaboration and network effects (Goodman et al. 2017).

Environmental Factors: Method of Analysis

Based on the analysis of the literature on dynamic capabilities and how businesses adapt to changing environments, we examine empirically how external factors influence business engagement in IfS, looking at different degrees of environmental change (Ambrosini et al. 2009). The literature on dynamic capabilities explains how businesses develop new capabilities in response to changing environments; therefore, it is useful in illustrating the organisational developments that take place in response to varying dynamics in the socio-technical system.

The research builds on 8 cases of companies performing IfS in different sectors. Data were collected through interviews with the CEO, innovation manager and sustainability manager of 8 companies spearheading IfS in Spain, which were selected due to their successful track record in IfS, as shown in Table 4.1 (apart from the studied cases, illustrative examples of cases more familiar with a wider audience have been included). When relevant, other persons involved in the management of IfS were interviewed, resulting in a total of 30 in-depth (from 45 minutes to 3 hours long), semi-structured interviews. The main topics covered the companies' IFS journey, actions taken to successfully engage in IfS and how they managed the relationship with the external environment (network, stakeholders, industry trends and megatrends…). These were analysed in the context of degrees of environmental dynamism as identified by Ambrosini et al. (2009): stable, dynamic and discontinuous environments. These were transcribed verbatim and analysed trough a three-step coding approach, building from concepts in the literature (deductive) but also finding new patterns in the data (inductive) (Gioia et al. 2012). Although the findings of this research can be generalised to other contexts (Polit and Beck 2010), it is limited by its context, meaning that there might also be alternative paths to reach the same point (Gresov and Drazin 1997).

Table 4.1 Main features of the sample companies

Industry	Number of employees	Turnover[a]	SOI strategy
Chemical	25	3.7	Holistic approach to SOI, developing products based on green chemistry and biotechnology, but also converting to a product-service system business model
Climate consultancy	35	2	Sustainability lies at the core of their activities. Provides advice on climate issues to businesses and policy-makers
Wind energy	6.431	2.846	It used to be a metallurgical company, which then streamlined to the development of wind turbines, mostly eco-designed
IT consultancy	3.000	247.7	This innovation-driven company has set up its own research institute to be able to experiment with socio-ecological projects that can then be translated to the whole firm
Technology development	39.000	2.940	It has a unit dedicated to sustainable products and services, while catering to societal demands lies at the core of its business model
Elevation systems	4.333	578	SOI is the element of differentiation of this firm in a highly competitive industry, and commitment to sustainability is widespread across all the firm operations
Fashion	70	20	Sustainability is a core value for the founder, which has impregnated the whole firm and is considered part of the firm's identity
Electric networks	1.500	320	Achieving higher levels of energy efficiency while eco-designing the distribution units is the core of its product strategy

[a]Turnover is measured in million euros. All data are provided for year 2014

Environmental Factors in Business Engagement in Innovation for Sustainability

The findings in the sample companies suggest that companies adapt to a different external environment that has a profound effect on both how the organisation develops IfS. The studied companies seem to be affected by different environmental factors at three different levels as it is conceptualised in Fig. 4.1. The degree of change in their environments can be: stable, dynamic and discontinuous environments. These levels may change for a firm or industry in a non-consecutive manner for instance, a company in a stable environment may jump-start to a discontinuous environment after a reputational disaster or the emergence of a radically new technology, while returning to a stable environment once adjustments have been made. Therefore, there is not a longitudinal relationship between these degrees of dynamism, they do not come after each other, but instead, they are determined

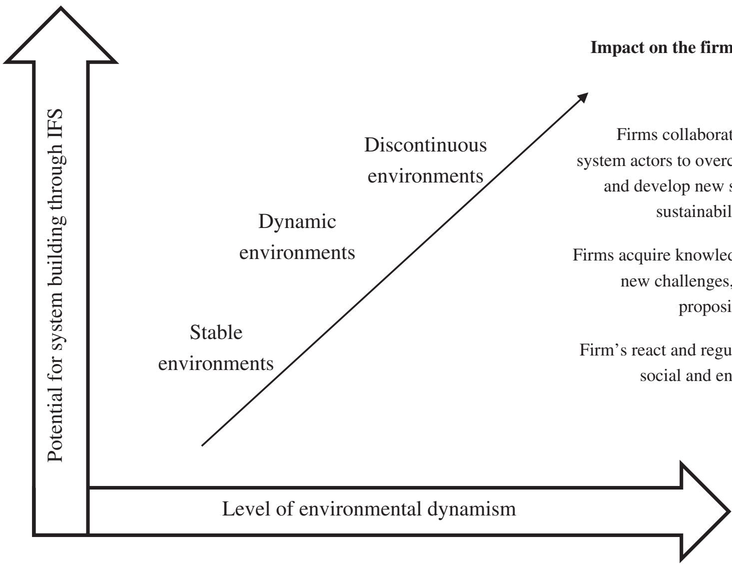

Fig. 4.1 Levels of environmental dynamism and impact on firms' IFS engagement

by external events. Three factors seem to be influential in shaping the organisational transformation for IfS: laws and regulations, socio-environmental challenges and discontinuous economic and technological change.

Stable Environments: Regulation and Policy

Stable environments are characterised by a continuous but incremental and relatively predictable pace of change. An example of such stable environment is found in highly regulated industries, such as the utilities sector, as illustrated by the interviews with Electric. In this highly regulated, high upfront investment sector, despite gradual regulatory change, it is rare to encounter shocks due to changing preferences or emergence of new competitors. Regulatory changes occur in due time; therefore, the environmental change is not radical, and companies have more time to fine-tune their routines and processes in response to changes. In the case of IfS, the legal and regulatory framework is often a driver for the focal company to develop new products or services or to create demand for existing innovations (Esty and Charnovitz 2012; Horbach et al. 2012). Although in other fields regulation seems to hinder innovation, in the case of IfS tightening environmental and social regulations—such as those requiring certain levels of greenhouse gas emissions—nurture the development of innovations resulting in compliant socio-ecological outcomes while the economic bottom-line is protected. Policy goals, such as the UN SDGs or commitment to sustainability programs like the circular economy (McDowall et al. 2017), also spur demand for innovations for sustainability. As an example, Nestlé has aligned its innovation strategy with the 42 SDGs in their field of business, with a twofold objective: (1) fulfilling the demand for such innovations raised by the SDGs, and (2) contributing to human nutrition and health, rural development, environmental sustainability and human rights (Nestlé 2017). Therefore, the existence of a regulatory framework that makes social and environmental requirements from firms stricter creates a stable but evolving environment to which companies gradually adapt. As a consequence, it is important for businesses to keep track of the upcoming advances in regulation and policy. Staying ahead of regulation through IfS saves costs of adaption and helps to tap into new markets.

Despite this, it must also be noted that regulation may also hinder the introduction of IfS, either because of absence of regulation and the application of the precautionary principle in case of radical novelties, or due to the lock-in of regulatory institutions to previous systems. An example of the latter applies to many innovations in the field of the circular economy, since the heavily regulated waste management arena often does not contemplate reuse or refurbishing for disposed of materials (Technopolis 2016). In this case, companies must adapt to such environment differently: rather than adapting towards compliance, companies act as advocates of a technology push, breaking through the existent socio-technical regime with technologies paired to viable sustainable business models.

Dynamic Environments: Rising Socio-environmental Challenges

In dynamic environments, companies respond to socio-environmental challenges posed by their business context through adapting IfS to these demands. Dynamic environments are characterised by the need to modify company strategies to adapt to changes in the environment beyond incremental adjustments, for instance, because of the entrance in the market of a new competitor or because of new customer demands. As explained by a representative of Elevation, their market is being completely reshaped by sustainability concerns of buyers, who need to comply with CO_2 emissions standards and compete for sustainable building certifications and awards. Companies with a strong commitment to sustainability will seek a holistic viewpoint from which to integrate the greatest number of issues possible. As compared to laws and regulations, which affect all companies in a sector in a given territorial limit, tackling socio-environmental challenges might be a choice of the company (because of commitment to sustainability, market opportunities or both) or a requirement of the community within which it operates. Hence, the benchmarking possibilities are reduced; path-dependencies and deliberate processes come into place in developing the necessary capabilities to adapt to these environments. However, the chances for distinguishing the company and rely on the firm's strengths also increase; therefore, although the complexity of the required changes increases, the opportunity to develop a competitive advantage based on differentiation also grows.

Tackling particular socio-environmental issues that are not spelled out in laws or policies requires a particular sustainability expertise, since the innovation required is far beyond compliance. As illustrated by representatives of Fashion, this is the case of their industry, in which regulations cover minimum standards of safety and well-being of workers and health and safety issues in clothing. The studied fashion company goes well beyond this, regularly engaging with its providers to ensure the well-being of their workers and working towards the inclusion of sustainable fibres in their designs. They have also established a slow fashion business model, guaranteeing the durability of their products and minimising the production, transport, storage and disposal activities that result in environmental harm. In these cases, companies need to adapt by acquiring this new knowledge not only about techniques, but also about sustainability direction, that will not be provided by existing standards or regulations. They can do so by integrating new sustainability knowledge into the company, by staying in touch with the needs of their stakeholders and developing absorptive capacity (Ben Arfi et al. 2018). Another option is to engage in partnerships or multi-stakeholder platforms, in which one of the partners provides expertise on the issue and how it may be tackled (Nidumolu et al. 2014; Phillips et al. 2017).

A good example of how companies are adapting to new landscapes is the challenge posed by the rise of non-communicable diseases derived mostly from diet, such as obesity and diabetes type II. This is a relatively new issue—at least at its current scale—to which several industries need to adapt. Food companies like Unilever (2017) are now focusing on prevention, by reducing the sugar levels of their products. However, this does not come without challenges, as tastiness and consumer preferences need to be taken into consideration. Therefore, a strong R&D effort is carried out by the firm, in close collaboration with customers and nutrition experts. Multi-stakeholder partnerships such as the Roundtable for Sustainable Palm Oil, despite its shortcomings, have also reshaped the industry attitude towards the sourcing and use of palm oil.

Discontinuous Environments: Discontinuous Economic and Technological Change

Finally, in some cases and different contexts, companies face discontinuous environments that push firms to develop innovations for sustainability not to be left behind, adapting to major changes and finding a way to sustain the economic, social and environmental contribution of the business through new markets and business models. This discontinuity may be social, environmental, economic or technological, but in any of the cases, it represents radical, sudden changes that companies to which companies must adapt. Discontinuous change may be local or global and affect all businesses, a certain industry or even a single company. For instance, the video-on-demand technologies, paired with the ubiquity of high-speed Internet connection, have profoundly changed the nature of the media industry. The Deepwater Horizon disaster caused a profound impact on BP, which had to adapt its strategies, but also triggers other developments, since policies on offshore drilling were modified in the aftermath of the environmental debacle. In any case, cultivating organisational resilience and slack is necessary to adapt to these changes, whether steadier (such as video-on-demand) or sudden (such as Deepwater Horizon). In order to be resilient, companies must acknowledge their engrailment in wider systems, building organisational strategies and a vision in relation to its surrounding environment. Only in such a way, it will be able to absorb shocks affecting the system and integrate change in the same way that the system does. In addition, sudden changes in the environment often trigger IfS; for instance, in the case of earthquakes, floods and droughts, they often result in increased risk-mitigating innovations (Miao and Popp 2014). But, beyond technological innovation, adapting to discontinuous change may require developing new organisational configurations and structures, learning new processes and transforming the company strategy and vision. In some cases, these processes are of considerable relevance owing to their transformative role in sustainable development, thus reconfiguring a firm's purpose and goals (van Kleef and Roome 2007).

For instance, in the face of natural disasters provoked by climate change and considering the reliance of the company on smallholders' production of cereal, the Kellogg Company has started working with them to build climate resilience (Rowling 2017). Kellogg is going beyond its role as buyer by constructing a collaborative business model in which it engages climate start-ups, producers and governments to develop a climate resilient value chain. Furthermore, the social awareness of the human rights violations in many textile companies' supply chain raised by the Rana Plaza disaster also activated new forms or organisational innovation. Beyond revisiting their own supply chains, textile companies have partnered with NGOs and unions to tackle the issue together (Reinecke and Donaghey 2015). These examples show how, in order to be adaptive and thrive in highly discontinuous environments, firms need to develop resilience by getting to know the other actors and dynamics in the system in which they develop their activities. These companies actively participate in the co-building of such system (Adams et al. 2016), rather than let themselves be swayed by external dynamics, collaborating with other stakeholders and establishing clear sustainability goals not only for the company itself, but for the whole system in which they operate.

Conclusion

In this chapter, we have explored how business organisations are related to the economic, social and natural environments in which they are embedded, and how changes in such environments affects their IfS activities. There are three major degrees of change. In stable environments, whereby change is mostly guided by regulations and policies, the firm must react to such changes; moreover, these may serve as a steer and anchor for the company to direct its IfS. Therefore, vigilance systems that ensure that the company anticipates these changes are essential. However, at so-called dynamic environments, companies adopt a more proactive role, for which they need to identify the socio-environmental challenges in their surrounding environment and acquire the necessary knowledge to tackle them through innovation, very often in partnership with stakeholders. Finally, in the case of discontinuous change, those businesses that realise their engrailment in a wider environment and work to grant resilience for the wider system will thrive in their IfS activities.

In a nutshell, this chapter shows that, apart from working on internal capabilities, businesses must also look outside and adapt to the main challenges in their environments to thrive and become more competitive through IfS activities. This calls for further research on outward-looking management of IfS, and how the relationship between businesses and their external environment can help to sustain economic, social and natural resilience.

This also has important implications for businesses. The research shows that, to successfully engage in IfS, companies must keep looking outside of the firm for new knowledge, new collaboration opportunities and building networks that will help them to acknowledge the dynamics of the system in which they operate. As environments become more discontinuous, successful companies become proactive agents of change for sustainability, maximising the impact not only for the firm, but also for their environment.

References

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Ambrosini, Véronique, Cliff Bowman, and Nardine Collier. 2009. "Dynamic capabilities: An exploration of how firms renew their resource base." *British Journal of Management* 20: S9–24.

Ben Arfi, Wissal, Lubica Hikkerova, and Jean-Michel Sahut. 2018. "External knowledge sources, green innovation and performance." *Technological Forecasting and Social Change* 129 (April): 210–20.

Bergek, Anna, and Christian Berggren. 2014. "The impact of environmental policy instruments on innovation: A review of energy and automotive industry studies." *Ecological Economics* 106 (October): 112–23.

Bocken, N. M. P., S. W. Short, P. Rana, and S. Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Bos-Brouwers, Hilke Elke Jacke. 2010. "Corporate sustainability and innovation in SMEs: Evidence of themes and activities in practice." *Business Strategy & the Environment* 19 (7): 417–35.

Boulding, K. E. 1966. *Environmental quality in a growing economy*. Washington, DC: Resources for the Future.

Dangelico, Rosa Maria, Pierpaolo Pontrandolfo, and Devashish Pujari. 2013. "Developing sustainable new products in the textile and upholstered furniture industries: Role of external integrative capabilities." *Journal of Product Innovation Management* 30 (4): 642–58.

Esty, Daniel, C., and Steve Charnovitz. 2012. "Green rules to guide innovation." *Harvard Business Review* (March): 120–23.

European Commission. 2012. *Sustainable growth—For a resource efficient, greener and more competitive economy*. http://ec.europa.eu/europe2020/europe-2020-in-a-nutshell/priorities/sustainablegrowth/index_en.htm.

Forrester, Jay Wright. 1968. *Principles of systems*. Pegasus Communications.

Franceschini, Simone, Mads Borup, and Jesús Rosales-Carreón. 2018. "Future indoor light and associated energy consumption based on professionals' visions: A practice-and network-oriented analysis." *Technological Forecasting and Social Change* 129: 1–11.

Fussler, Claude, and Peter James. 1996. *Driving eco-innovation: A breakthrough discipline for innovation and sustainability*. London: Pitman Publishing.

Geels, Frank W., and Johan Schot. 2007. "Typology of sociotechnical transition pathways." *Research Policy* 36 (3): 399–417.

Geissdoerfer, Martin, Paulo Savaget, Nancy M. P. Bocken, and Erik Jan Hultink. 2017. "The circular economy a new sustainability paradigm?" *Journal of Cleaner Production* 143 (February): 757–68.

Gioia, Dennis A., Kevin G. Corley, and Aimee L. Hamilton. 2012. "Seeking qualitative rigor in inductive research: Notes on the Gioia methodology." *Organizational Research Methods*, July. https://doi.org/10.1177/1094428112452151.

Goodman, Jennifer, Angelina Korsunova, and Minna Halme. 2017. "Our collaborative future: Activities and roles of stakeholders in sustainability-oriented innovation." *Business Strategy and the Environment*, January.

Gresov, Christopher, and Robert Drazin. 1997. "Equifinality: Functional equivalence in organization design." *Academy of Management Review* 22 (2): 403–28.

Hansen, Erik G., Friedrich Grosse-Dunker, and Ralf Reichwald. 2009. "Sustainability innovation cube—A framework to evaluate sustainability-oriented innovations." *International Journal of Innovation Management* 13 (4): 683–713.

Horbach, Jens, Christian Rammer, and Klaus Rennings. 2012. "Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull." *Ecological Economics* 78 (June): 112–22.

Inigo, Edurne A., and Laura Albareda. 2016. "Understanding sustainable innovation as a complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.

Jay, Jason, and Marine Gerand. 2015. "Accelerating the theory and practice of sustainability-oriented innovation." *Mit Sloan School Working Paper* 5: 148–15.

Keskin, Duygu, Jan Carel Diehl, and Nelliene Molenaar. 2013. "Innovation process of new ventures driven by sustainability." *Journal of Cleaner Production*, Sustainable Innovation and Business Models, 45 (April): 50–60.

Loorbach, Derk, and Katinka Wijsman. 2013. "Business transition management: Exploring a new role for business in sustainability transitions." *Journal of Cleaner Production*, Sustainable Innovation and Business Models, 45 (April): 20–28.

Lüdeke-Freund, F., L. Massa, N. Bocken, A. Brent, and J. Musango. 2016. "Business models for shared value: Main report." *Network for Business Sustainability South Africa*. http://www.nbs.net.

Maletič, Matjaž, Damjan Maletič, and Boštjan Gomišček. 2018. "The role of contingency factors on the relationship between sustainability practices and organizational performance." *Journal of Cleaner Production* 171 Supplement C: 423–33.

McDowall, Will, Yong Geng, Beijia Huang, Eva Barteková, Raimund Bleischwitz, Serdar Türkeli, René Kemp, and Teresa Doménech. 2017. "Circular economy policies in China and Europe." *Journal of Industrial Ecology* 21 (3): 651–61.

Meadows, Donella H., Dennis L. Meadows, J. Randers, and W. W. Behrens. 1972. *The limits to growth*. New York: Universe Books.

Miao, Qing, and David Popp. 2014. "Necessity as the mother of invention: Innovative responses to natural disasters." *Journal of Environmental Economics and Management* 68 (1): 280–95.

Mulgan, Geoff, Simon Tucker, Ali Rushanara, and Ben Sanders. 2007. "Social innovation: What it is, why it matters, how it can be accelerated." The Young Foundation.

Murray, Alan, Keith Skene, and Kathryn Haynes. 2017. "The circular economy: An interdisciplinary exploration of the concept and application in a global context." *Journal of Business Ethics* 140 (3): 369–80.

Nestlé. 2017. "Our commitments". Last accessed December 14, 2017. https://www.nestle.com/csv/what-is-csv/commitments.

Nidumolu, Ram, C. K. Prahalad, and M. R. Rangaswami. 2009. "Why sustainability is now the key driver of innovation." *Harvard Business Review* 87 (9): 56–64.

Nidumolu, Ram, Jib Ellison, John Whalen, and Erin Billman. 2014. "The collaboration imperative." *Harvard Business Review* 92 (4): 76–84.

Organisation for Economic Cooperation and Development (OECD). 2010. *Eco-innovation in industry: Enabling green growth*. Paris: OECD Publications.

Pfitzer, Marc, Valerie Bockstette, and Mike Stamp. 2013. "Innovating for shared value." *Harvard Business Review* September: 1–9.

Philips. 2018. "Economic sustainability with circular economy elements." Accessed July 21, 2018. Lighting.philips.com http://www.lighting.philips.com/main/services/circular-lighting.

Phillips, Wendy, Elizabeth A. Alexander, and Hazel Lee. 2017. "Going it alone won't work! The relational imperative for social innovation in social enterprises." *Journal of Business Ethics*, June: 1–17.

Polit, Denise F., and Cheryl T. Beck. 2010. "Generalization in quantitative and qualitative research: Myths and strategies." *International Journal of Nursing Studies* 47 (11): 1451–58.

Reinecke, Juliane, and Jimmy Donaghey. 2015. "After Rana Plaza: Building coalitional power for labour rights between unions and (consumption-based) social movement organisations." *Organization* 22 (5): 720–40.

Rowling, M. 2017. "Wanted: Business partners to build climate resilience." *Thomson Reuters Foundation News* 12 November. Accessed December 14, 2017. https://news.trust.org/item/20171112132829-9gswi.

Schiederig, Tim, Frank Tietze, and Cornelius Herstatt. 2012. "Green innovation in technology and innovation management—An exploratory literature review." *R&D Management* 42 (2): 180–92.

Seebode, Dorothea, Sally Jeanrenaud, and John Bessant. 2012. "Managing innovation for sustainability." *R&D Management* 42 (3): 195–206.

Stubbs, Wendy, and Chris Cocklin. 2008. "Conceptualizing a sustainability business model." *Organization & Environment* 21 (2): 103–27.

Technopolis. 2016. "*Regulatory barriers for the circular economy*." Report for the European Commission, Ref. Ares (2016)6309572. Accessed December 14, 2017. http://ec.europa.eu/DocsRoom/documents/19742.

Unilever. 2017. "Reducing sugar." Accessed December 14, 2017. https://www.unilever.com/sustainable-living/improving-health-and-well-being/improving-nutrition/helping-to-tackle-obesity/reducing-sugar/.

United Nations Environmental Programme, UNEP. 2011. *Decoupling natural resource use and environmental impacts from economic growth*. Paris: United Nations.

United Nations, General Assembly. 2015. "Transforming our World: The 2030 agenda for sustainable development." *A/RES* 70 (1): 1–35.

van Kleef, J. A. G., and N. J. Roome. 2007. "Developing capabilities and competence for sustainable business management as innovation: A research agenda." *Journal of Cleaner Production* 15 (1): 38–51.

World Commission on Environment and Development, WCED. 1987. *Our common future*. New York: Oxford University Press and United Nations.

5

Circular Business Model Innovation for Sustainable Development

Eva Guldmann and Rikke Dorothea Huulgaard

Introduction

The need for a transition to sustainable development has been discussed for decades. In 1987, the World Commission on Environment and Development published *Our Common Future*, which emphasised the need for companies to support this transition (WCED 1987), and Elkington (1997) later suggested companies take a triple bottom line approach in which equal attention is given to economic prosperity, environmental protection and social equity, as a means of providing such support.

Recent findings nevertheless suggest that the incremental improvement of product and process designs that companies have engaged in since then is insufficient to attain sustainable development (Abdelkafi

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and Täuscher 2016; Short et al. 2014). Indeed, current levels of resource consumption and waste generation are unsustainable and lead to degradation of ecological systems (WWF 2016; WBCSD 2010). A more radical approach that aligns business operations with long-term sustainability is needed instead, and business model innovation aimed at crafting more sustainable business models offers a possible avenue (Geissdoerfer et al. 2016; Bocken et al. 2013; Boons and Lüdeke-Freund 2013; Porter and Kramer 2011).

Circular business model innovation (CBMI) is a particular kind of sustainable business model innovation that aligns with the circular economy paradigm. Circular economy is based on keeping products and materials in use for as long as possible and utilised as much as possible via maintenance, repair, reuse, refurbishment, remanufacturing and sharing of products and eventually via recycling of materials (Webster 2017; Ellen MacArthur Foundation 2013; Bocken et al. 2016a). The aim is a regenerative economy where economic value is created from a continual flow of reused materials and products over time (Bakker et al. 2014) by capitalising on the value embedded in used products (Bocken et al. 2016a; Linder and Williander 2017). Circular economy thus contrasts with the prevailing linear economy, which is founded on a take-make-dispose paradigm (Ellen MacArthur Foundation 2013) and focuses on one-time sales of goods as a key driver for economic value creation (Bakker et al. 2014).

The promising transition from a business model based on linear economy to one based on circular economy nevertheless constitutes a complex innovation challenge (Guldmann and Huulgaard 2017; Bocken et al. 2018). It commands that companies explore new and unfamiliar terrain, where both the business model and the associated values, beliefs, taken-for-granted notions and artefacts of the company (Zollo et al. 2013) have to be modified. The demanding CBMI process remains an under-researched area resulting in a lack of knowledge about these innovation processes and a lack of frameworks to support these (Urbinati et al. 2017; Bocken et al. 2018), which delays the uptake of circular business models (CBMs) (Linder and Williander 2017) and the transition to sustainable development (Boons and Lüdeke-Freund 2013). In this chapter, we take steps to close this gap in current knowledge by outlining three distinct types of CBMI based on our research.

To arrive at an understanding of the specifics of the CBMI processes, we first need to clarify the notions of CBM, CBMI and business experimentation, which we do in the theoretical background. In the research design section, we explain how the CBMI types were developed before outlining the characteristics of each type in the presentation of the model for CBMI and, finally, considering the implications for practitioners.

Theoretical Background

Circular Business Models

A business model describes how a company operates (Richardson 2008). It defines the value proposition, i.e. the products or services offered by the company; how value is provided upstream in the value chain via partners, resources and activities and downstream via specific channels, customer segments and customer relationships; and, finally, how the company captures value from its revenue streams and cost structures (Richardson 2008; Osterwalder and Pigneur 2010). The centre of Fig. 5.1 illustrates these generic business model elements.

A CBM can be defined as a business model, where the business model elements are designed to jointly slow, close and/or narrow resource loops in an economically profitable way (Bocken et al. 2018; Bocken et al. 2016b). CBMs thus incorporate environmental and economic sustainability, whereas social sustainability is less prominent in CBMs compared to other sustainable business models (Geissdoerfer et al. 2017; Bocken et al. 2014).

A slowing of resource loops, i.e. of the rate at which resources flow through the economy, is attained by (Ellen MacArthur Foundation 2013; Bocken et al. 2016a)

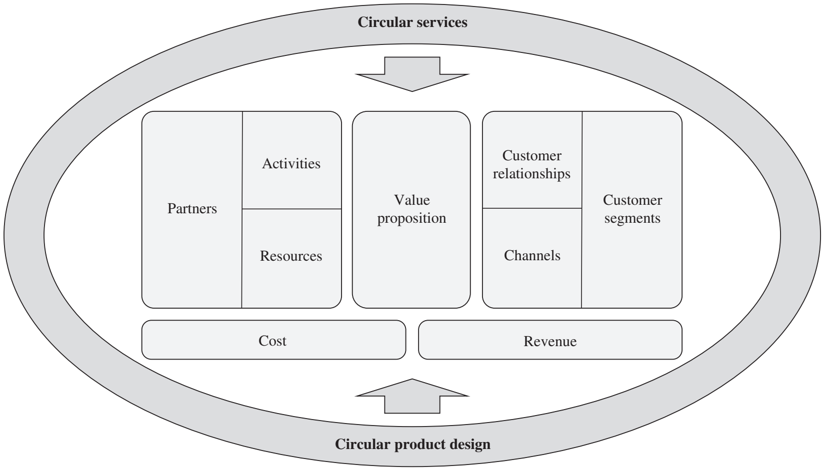

Fig. 5.1 In a CBM, the business model is redesigned to encompass circular services and product design. Adapted from Osterwalder and Pigneur (2010), Bocken et al. (2016a) and Guldmann and Remmen (2018)

- maintaining and repairing products
- sharing and reusing products
- upgrading, refurbishing and remanufacturing products.

While a closing of resource loops to minimise resource loss is attained by (Ellen MacArthur Foundation 2013; Bocken et al. 2016a)

- recycling materials.

Finally, a narrowing of resource loops to improve resource efficiency can be attained via optimisation of product design and manufacturing processes (e.g. product dematerialisation and lean manufacturing initiatives). Strategies to narrow resource loops provide a valuable addition to business models that slow and close resource loops but cannot constitute CBMs in themselves (Bocken et al. 2016a).

It follows that a CBM is characterised by the deliberate design of two central components: *Products* that can be repaired, reused, remanufactured, recycled etc. and *services* (e.g. offering repairs and upgrades, deploying leasing, sharing and take-back models and engaging in resale, remanufacturing or recycling activities) that utilise these product features in a way that creates value to the customer, see Fig. 5.1. There are numerous possible configurations of a CBM, and the CBM should combine the circular services and product design features that are most appropriate for the individual company (see e.g. Guldmann (2016) for a number of examples).

Circular Business Model Innovation

The process of making changes to existing business models to arrive at new configurations of the business model (in a mature company) or creating entirely new business models (in a start-up or within a new business area of a mature company) is termed business model innovation (Osterwalder and Pigneur 2010; Mitchell and Coles 2003).

CBMI is concerned with the incorporation of circular services and product design in an existing or a new business model and commands a reconfiguration of multiple, if not all, business model elements, potentially affecting every part of how the company operates, its existing structures, procedures, values, beliefs, etc. (Zollo et al. 2013). Implementing one of the most common CBMs, product recycling, is a case in point: Optimal recycling requires use of materials that are free from hazardous substances, separable and technically recyclable, as well as economically feasible to recycle. Integrating these considerations into the product design is likely to affect which *partners* the company works with, its *activities*, *costs* and *value proposition*. Ensuring the redesigned products are recycled via enabling services demands an incentive system and new kinds of interaction with customers and, hence, involves changes to the *customer relationships* and the *revenue model*. Furthermore, it requires effective reverse logistics and recycling facilities that again point to a need for new business *partners*.

CBMI can be perceived as an ongoing process of organisational learning and change (Halme 2002) and in order to get this process started it can be beneficial to minimise the number of modifications required to an existing business model in an incumbent company by focussing on either circular services or circular product design in isolation. However, in our understanding, it is necessary to eventually consider circular product design and services *together* to yield maximum environmental benefit from the CBMI; merely designing products that *could* be remanufactured, recycled, etc. without acting to ensure this happens or introducing circular services *without* optimising the product design for such services should be considered a half measure. While product design changes are a concern of the focal company, services do not have to be operated by the manufacturing company itself; instead, the services could be made available through arrangements with third parties. H&M, for instance, cooperates with the clothing collection, reuse and recycling company I:CO to offer a take-back scheme that ensures garments are reused or recycled (Guldmann 2016).

Innovation processes are concerned with a recombination of novel or existing parts to form a new whole (Hargadon 2014) and they are open, uncertain, characterised by exploration, unexpected outcomes and an end destination that is not known beforehand (Geels et al. 2008). These characteristics also hold true for CBMI. It is a challenging type of innovation for a number of reasons: First, the innovation process is likely to prompt a redefinition of the dominant business logic in the form of shifting from (only) generating turnover from product sales to (also) generating turnover from services (Chesbrough 2010; Schaltegger et al. 2012). Second, what will and will not work in a new business model often cannot be fully anticipated in advance but must, instead, be learned over time (McGrath 2010). Third, most companies and networks are locked in organisational, technological, industrial, societal and institutional structures (Doganova and Karnøe 2012; Unruh 2002) that impair reconfiguration of the business model and the required knowledge exchange across existing structures, routines and institutions (Clausen and Yoshinaka 2007). Finally, sustainable business models, including CBMs, tend to require new business partnerships and involve more internal and external actors than linear business models (Roome and Louche 2016).

Business Experimentation

These challenges render it imperative to support the difficult transition towards CBMs and business experimentation is central in this regard, not least as a means of minimising uncertainties (Chesbrough 2010; McGrath 2010; Thomke 2003; Weissbrod and Bocken 2017; Bocken et al. 2018; Linder and Williander 2017). Experimentation can help the company explore the diverse possibilities for value creation and learn what works in which particular business context (Bocken et al. 2018).

The experimentation can take on many forms and can take place within or across companies (McGrath 2010; Bocken et al. 2018; Guldmann and Remmen 2018). The idea is to articulate possible CBM configurations and receive feedback on what will and will not work in the particular business context and to integrate this knowledge in iterative cycles of progressively refined configurations of the business model (Bocken et al. 2018; Guldmann and Remmen 2018). Business experimentation primarily involves the focal company and sometimes a few trusted external stakeholders such as customers or suppliers (Bocken et al. 2018; Guldmann and Remmen 2018; Weissbrod and Bocken 2017).

Generating CBM ideas, mapping out extant and new business models (e.g. in a business model canvas similar to Fig. 5.1) and discussing these opportunities comprise examples of company-internal tools for experimentation (Chesbrough 2010; Weissbrod and Bocken 2017; Guldmann and Remmen 2018). Customer interviews, a market or focus group study and test of prototypes, on the other hand, constitute more market-oriented tools (Linder and Williander 2017; McGrath 2010; Bocken et al. 2018; Guldmann and Remmen 2018) and so does a high-fidelity test launch in a specific market (Thomke 2003).

Different Company Approaches to Sustainable Innovation

The organisational context is important to consider in CBMI, and a company's sustainability strategy is one aspect that influences the process. Companies can be grouped into three categories depending on their sustainability strategy and the associated level of business model innovation.

The first group of companies is oriented at internal, incremental innovation for sustainability to reduce harm, typically as a response to regulatory stimuli (Adams et al. 2016). In this group of companies, no or only moderate alterations to the business model are necessary to pursue the company's sustainability strategy (Schaltegger et al. 2012). The second group of companies is engaged in farther reaching innovation for sustainability and a desire to create shared value through collaboration with immediate stakeholders in the value chain (Adams et al. 2016). One or more elements in the business model are occasionally modified to improve the sustainability of the business model, but the core business is not challenged (Schaltegger et al. 2012). A third group of companies collaborates with multiple stakeholders to induce system-level changes and strives for a net positive impact from the business operations through radical innovation for sustainability (Adams et al. 2016). Sustainability is an integral part of the companies in this group, and they are open to more fundamental changes to their business model (Schaltegger et al. 2012).

Research Design

A Multiple-Case Study

The model for CBMI that is developed in this chapter is founded on empirical research in eight Danish manufacturing companies. The aim of our collaboration with these companies was to examine the potential of CBMI as a driver for sustainability and to understand the innovation process better by generating and developing CBM ideas together with the case companies through internal and external experimentation.

The study was designed as a longitudinal multiple-case study that allowed us to study the CBMI processes deeply and extensively over time and together the case companies provided a rich empirical foundation (Orum 2015; Yin 2014) for the development of the model for CBMI that is presented in Table 5.1. The model was derived from an abductive interchange (Saunders et al. 2015) between the empirical data from the multiple-case study and the literature presented in the theoretical background and is thus the result of iterative cycles of refinement.

Data was captured in a case study database (Yin 2014) containing memos and minutes from our interventions at the companies, field notes and documents (e.g. sustainability reports). In some companies, these data were supplemented with formal interviews, and the collaboration with the eight case companies has so far lasted between one and a half and four years.

Case Companies

The companies we collaborated with are clothing companies AMOV, Better World Fashion and KnowledgeCotton Apparel, textile companies Gabriel and Schilder and Brown, mechatronics companies Danfoss and Grundfos and water cooler company Kuvatek. The case companies in the study thus operate in different industries and represent different sizes. Three of the companies had previous experience with CBMs, while the concept of circular economy was new for the remaining five companies. Irrespective of the outset, the companies were interested in exploring (further) business potentials from CBMs and open to CBMI experimentation. The innovation process was organised to fit the individual company settings and was adjusted as the project progressed to integrate new insights and take advantage of new opportunities that emerged or steer around ideas that proved to be dead-ends, which resulted in eight unique CBMI processes.

We aimed for a close collaboration with the companies and found an engaged scholarship approach (Van de Ven 2007; Wells 2016) appropriate to this end. Engaged scholarship is a type of action research that can be defined as: '[…] a collaborative form of inquiry in which academics and practitioners leverage their different perspectives and competencies to coproduce knowledge about a complex problem or phenomenon that exists under conditions of uncertainty found in the world' (Van de Ven and Johnson 2006, p. 803).

A Model for Circular Business Model Innovation

Based on our analysis of the empirical data, we organise the CBMI process into three types; *internal, hybrid* and *systemic CBMI* (see Table 5.1). Internal CBMI focuses on the development of CBMs for implementation within the company that do not interfere with the existing business model of the core business; hybrid CBMI combines new circular services and product designs with the existing business model; and systemic CBMI improves existing CBMs through new or refined circular services and/or product designs. Each type represents distinct opportunities and challenges and is defined by a unique setting for the innovation process in terms of

- a specific foundation for the CBMI process in the form of the existing business model, employees driving the CBMI process and the sustainability strategy,
- a set of characteristics of the CBMI, i.e. the goal of the CBMI, the type of experimentation that is conducted and internal and external stakeholders involved,
- the type of CBM that is explored.

In the following, we describe the three types of CBMI and elaborate these by using examples from our case companies. Note, that no company will fit every dimension of the model perfectly, but is likely to fall predominantly within one of the CBMI types.

Internal Circular Business Model Innovation

An internal CBMI process is typical of a company that has a conventional linear business model and where individual staff members drive the innovation process. The company's sustainability strategy typically

Table 5.1 Model for Circular Business Model Innovation (CBMI)

	Internal CBMI	Hybrid CBMI	Systemic CBMI
Point of departure and organisation of CBMI process	Linear company where CBMI is staff driven	Linear company where CBMI is management driven	Circular company where management drives further CBMI
Sustainability strategy	Aims to balance profitable business and environmental improvements. Applies well-established eco-efficiency methods	Aims to be more sustainable than competitors. Challenges own and value chain partners' environmental performance on a continuous basis	Aims to transform the role of business in society and have a net positive impact. Continuously seeks to develop novel solutions in close collaboration with value chain partners
Goal of CBMI experimentation	Clarify company position on circular economy. Preliminary assessment of CBM business potential through the development of easy-to-implement circular services and/or products	Build confidence in CBM business potential by developing circular services and/or products to supplement the existing, predominantly linear business model	Strengthen commitment to circular economy. Refine existing CBM in terms of value proposition, profitability and scalability through development of new or improved circular services and/or products
Type of experimentation	Ad hoc experimentation commenced within a single department. Prefers safe arenas such as internal workshops or collaboration with circular economy knowledge experts from outside the value chain	Structured experimentation process. Exploring attitudes of and collaboration opportunities with existing or new value chain partners	Continuous experimentation. Actively engaging value chain partners upstream and downstream in creation of new solutions

(continued)

Table 5.1 (continued)

	Internal CBMI	Hybrid CBMI	Systemic CBMI
Involvement of internal and external stakeholders	Focuses on internal dialogue. Minimal value chain partner involvement	Focuses on internal collaboration and/or dialogue with trusted or new value chain partners	Engages internal and external stakeholders in the experimentation. Focuses on developing existing collaboration with value chain partners or establishing collaboration with new value chain partners
Explored types of CBM	Internal CBM that incorporates resource efficiency improvements and recycling, for instance in the manufacturing process, thus narrowing and/or closing resource loops The internal CBM is implemented locally within the company and does not interfere with the core business	Hybrid CBM that incorporates selected circular services and/or product design features The hybrid CBM complements the existing business model by closing and/or slowing resource loops	Systemic CBM that incorporates improved circular services and product designs into the business model The systemic CBM aligns all or most business model elements to close and/or slow resource loops in an optimal way

focuses on balancing profitable business and environmental improvement through well-established eco-efficiency methods. Global mechatronics company, Danfoss, which manufactures energy-efficient components for industrial use, is an illustrative example of internal CBMI. The experimentation in Danfoss initially focussed on updating a product development guideline, which was an activity that involved only the sustainability department. Later, it was possible to gather organisational support for a cross-organisational workshop and for experimentation with partners from outside the value chain. The CBMI recently resulted in plans to optimise the resource efficiency of the manufacturing process by introducing what we term an *internal CBM*, i.e. a CBM that focuses on narrowing or closing resource loops, which is implemented inside the company.

Hybrid Circular Business Model Innovation

Hybrid CBMI is found in companies, where the business model is also linear, but where the CBMI process is driven by management. The sustainability strategy emphasises the aim of being more sustainable than competitors and challenges own and value chain partners' environmental performance on a continuous basis. The small sustainable men's wear company, KnowledgeCotton Apparel exemplifies hybrid CBMI. The company offers apparel from organic and recycled materials and the CBMI focused on developing a new store concept that would incorporate multiple circular services and product designs such as clothing repairs and redesign, sale of second-hand clothes and clothing collection for recycling. The explored business model, which we term a *hybrid CBM*, combined the existing business model based on sales of organic cotton clothes with multiple circular services and product designs to close and slow resource loops. KnowledgeCotton Apparel tested assumptions behind the new business model through internal experiments involving a team of managers, such as contrasting existing sustainability efforts and new CBM opportunities, and through external experiments, such as interviews with sales agents.

Systemic Circular Business Model Innovation

Systemic CBMI takes place in companies that are already circular, but where management is interested in improving the existing CBM. The sustainability strategy is oriented at redefining and transforming companies, so that they have a net positive impact and the company actively pursues this objective. The CBMI process at the start-up, Better World Fashion, illustrates systemic CBMI. The company manufactures jackets from recycled leather and offers leasing and take-back services for the jackets to resell them or recycle them into new jackets. The company owners were eager to refine the existing CBM and open to experimentation and collaboration. For instance, the company tested customer acceptance of its existing products and business model at a music festival and collaborated closely with the manufacturer of the jackets to develop the best selection and cutting methods for the recycled leather. As a result of the continued CBMI, the company recently expanded the product portfolio with bags and wallets produced from leather cuttings from the manufacturing of jackets, thus expanding the value proposition and optimising profitability of the existing CBM. The new business model is an example of what we term *systemic CBM* in which an existing CBM is developed further with improved circular services and/or product designs to close and slow resource loops in an optimal way.

Implications for Practitioners

The model for CBMI provides an overview of the innovation process, which could be useful to both companies that are new to CBMI and companies that are familiar with this sort of innovation. Practitioners can thus apply the model to guide the CBMI process in a company, and the first step is to clarify what the company's current foundation for CBMI is. The foundation corresponds to the *point of departure and organisation of CBMI process* and the *sustainability strategy* in the model and it indicates what type of CBMI is likely to be most relevant to the company. Based on this categorisation, the model can inform what sort of experimentation to engage in, which stakeholders to involve and what outcomes to aim for in the innovation process.

Our research has shown that the CBMI process generates organisational learning. This learning relates to clarification of the business potentials of concrete CBMs and obstacles to the development and implementation of these. It also relates to a beginning redefinition of the dominant business logic and other locked-in structures in and around the company. Learning took place in all case companies regardless of the type of CBMI the company was engaged in during our collaboration. It thus seems advisable to avoid an excessive focus on the starting point and concrete outcomes of the CBMI process and instead focus on organisational learning aspects and the fact that the CBMI process should be regarded part of the company's ongoing sustainability journey.

Conclusion

A transition to sustainable development is supported by the development and implementation of CBMs, but the needed business model innovation process is challenging and not well described in the literature. The aim of the model for CBMI developed in this chapter is to contribute to an understanding of how companies in different settings can engage in CBMI. The chapter demonstrates that companies can engage in three different types of CBMI, i.e. internal, hybrid and systemic CBMI, and outlines the process characteristics of each type. Recognising the differences between these CBMI types can be useful for practitioners and scholars, who want to support companies in a transition to, or a refinement of, CBMs.

Limitations and Further Research

The companies that participated in our research were sustainability-oriented and, at a minimum, interested in learning about CBMs. Consequently, the first type of CBMI in the model pertains to companies with an internally focused, but not absent, CBMI process, whereas companies without interest in CBMs are not represented in the current model. Further research is needed to determine how to engage this group of companies in CBMI and integrate it into the model. Moreover, as action researchers, we actively influenced the process of CBMI in the case companies and more research is needed to establish whether the model applies to CBMI processes where no external circular economy knowledge and agency is employed.

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References

Abdelkafi, Nizar, and Karl Täuscher. 2016. "Business models for sustainability from a system dynamics perspective." *Organization & Environment* 29 (1): 74–96.

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Bakker, Conny A., Marcel C. den Hollander, Ed van Hinte, and Yvo Zijlstra. 2014. *Products that last—Product design for circular business models*, 1st ed. Delft, The Netherlands: TU Delft Library.

Bocken, Nancy M. P., Conny Bakker, Ingrid de Pauw, and Bram van der Grinten. 2016a. "Product design and business model strategies for a circular economy." *Journal of Industrial and Production Engineering* 33 (5): 308–20.

Bocken, Nancy M. P., Ilka Weissbrod, and Mike Tennant. 2016b. "Business model experimentation for sustainability." In *Sustainable design and manufacturing*, edited by Rossi Setchi, Robert J. Howlet, Ying Liu, and Peter Theobald, 297–306. Cham: Springer.

Bocken, Nancy M. P., Cheyenne S. C. Schuit, and Christiaan Kraaijenhagen. 2018. "Experimenting with a circular business model: Lessons from eight cases." *Environmental Innovation and Societal Transitions* 28: 79–95.

Bocken, Nancy M. P., Samuel Short, Padmakshi Rana, and Steve Evans. 2013. "A value mapping tool for sustainable business modelling." *Corporate Governance* 13 (5): 482–97.

Bocken, Nancy M. P., Samuel Short, Padmakshi Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Chesbrough, Henry. 2010. "Business model innovation: Opportunities and barriers." *Long Range Planning* 43: 354–63.

Clausen, Christian, and Yutaka Yoshinaka. 2007. "Staging socio-technical spaces: Translating across boundaries in design." *Journal of Design Research* 6 (1–2): 61.

Doganova, Liliana, and Peter Karnøe. 2012. *The innovator's struggle to assemble environmental concerns to economic worth: Report to Grundfos New Business*. Bjerringbro, Denmark: Grundfos New Business. Accessed September 6, 2018. http://vbn.aau.dk/files/197165498/grundfos.pdf.

Elkington, John. 1997. *Cannibals with forks: The triple bottom line of 21st century business*. Oxford: Capstone Publishing.

Ellen MacArthur Foundation. 2013. Towards the circular economy vol. 2: Opportunities for the consumer goods sector. Accessed July 19, 2018. https://www.ellenmacarthurfoundation.org/assets/downloads/publications/TCE_Report-2013.pdf.

Geels, Frank W., Marko P. Hekkert, and Staffan Jacobsson. 2008. "The dynamics of sustainable innovation journeys." *Technology Analysis & Strategic Management* 20 (5): 521–36.

Geissdoerfer, Martin, Nancy M. P. Bocken, and Erik Jan Hultink. 2016. "Design thinking to enhance the sustainable business modelling process—A workshop based on a value mapping process." *Journal of Cleaner Production* 135: 1218–32.

Geissdoerfer, Martin, Paulo Savaget, Nancy M. P. Bocken, and Erik Jan Hultink. 2017. "The circular economy—A new sustainability paradigm?" *Journal of Cleaner Production* 143 (02): 757–68.

Guldmann, Eva. 2016. *Best practice examples of circular business models*. Copenhagen, Denmark: Danish Environmental Protection Agency. Accessed April 20, 2018. https://www2.mst.dk/Udgiv/publications/2016/06/978-87-93435-86-5.pdf.

Guldmann, Eva, and Rikke Dorothea Huulgaard. 2017. "Challenges to circular business modeling." In *Towards a greener challenge & evolution in the framework of the circular economy*, edited by Konstantinos Aravossis.

Proceedings of the 18th European roundtable on sustainable consumption and production, 21–29. Thessaloniki, Greece: Grafima Publications.

Guldmann, Eva, and Arne Remmen. 2018. *Towards circular business models: Experiences in eight Danish companies*. Copenhagen, Denmark: Danish Environmental Protection Agency. Accessed April 20, 2018. https://www2.mst.dk/Udgiv/publications/2018/04/978-87-93614-97-0.pdf.

Halme, Minna. 2002. "Corporate environmental paradigms in shift: Learning during the course of action at UPM–Kymmene." *Journal of Management Studies* 39 (8): 1087–1109.

Hargadon, Andrew. 2014. "Brokerage and innovation." In *The Oxford handbook of innovation management*, edited by Mark Dodgson, David M. Gann, Nelson Phillip (pp. 163–80). New York: Oxford University Press.

Linder, Marcus, and Mats Williander. 2017. "Circular business model innovation: Inherent uncertainties." *Business Strategy and the Environment* 26 (2): 182–96.

McGrath, Rita Gunther. 2010. "Business models: A discovery driven approach." *Long Range Planning* 43: 247–61.

Mitchell, Donald, and Carol Coles. 2003. "The ultimate competitive advantage of continuing business model innovation." *Journal of Business Strategy* 24 (5): 15–21.

Orum, Anthony M. 2015. "Case study: Logic." In *International encyclopedia of the social & behavioral sciences*, edited by James D. Wright, 2nd ed., 202–7. New York: Elsevier.

Osterwalder, Alexander, and Yves Pigneur. 2010. *Business model generation: A handbook for visionaries, game changers, and challengers*, 1st ed. Hoboken, NJ: Wiley.

Porter, Michael E., and Mark R. Kramer. 2011. "Creating shared value: How to reinvent capitalism—And unleash a wave of innovation and growth." *Harvard Business Review* 89: 62–77.

Richardson, James. 2008. "The business model: An integrative framework for strategy execution." *Strategic Change* 17 (5–6): 133–44.

Roome, Nigel, and Céline Louche. 2016. "Journeying toward business models for sustainability." *Organization & Environment* 29 (1): 11–35.

Saunders, Mark N. K., David E. Gray, Paul Tosey, and Eugene Sadler-Smith. 2015. "Concepts and theory building." In *A guide to professional doctorates in business and management*, edited by Lisa Anderson, Jeff Gold, Jim Steward, & Richard Thorpe, 35–56. London, UK: SAGE.

Schaltegger, Stefan, Florian Lüdeke-Freund, and Erik G. Hansen. 2012. "Business cases for sustainability and the role of business model innovation:

Developing a conceptual framework." *International Journal of Innovation and Sustainable Development* 6 (2): 95–119.
Short, Samuel W., Nancy M. P. Bocken, Claire Y. Barlow, and Marian R. Chertow. 2014. "From refining sugar to growing tomatoes." *Journal of Industrial Ecology* 18 (5): 603–18.
Thomke, Stefan H. 2003. *Experimentation matters: Unlocking the potential of new technologies for innovation*. Boston: Harvard Business Press.
Unruh, Gregory C. 2002. "Escaping carbon lock-in." *Energy Policy* 30 (4): 317–25.
Urbinati, Andrea, Davide Chiaroni, and Vittorio Chiesa. 2017. "Towards a new taxonomy of circular economy business models." *Journal of Cleaner Production* 168: 487–98.
Van de Ven, Andrew H. 2007. *Engaged scholarship: A guide for organizational and social research*. New York: Oxford University Press.
Van de Ven, Andrew H., and Paul E. Johnson. 2006. "Knowledge for theory and practice." *Academy of Management Review* 31 (4): 802–21.
WBCSD. 2010. *Vision 2050: The new agenda for business*. Conches-Geneva, Switzerland: World Business Council for Sustainable Development. Accessed September 6, 2018. https://docs.wbcsd.org/2018/02/Vision2050.pdf.
WCED—World Commission on Environment and Development. 1987. *Our common future*. Oxford: Oxford University Press.
Webster, Ken. 2017. *The circular economy: A wealth of flows*, 2nd ed. Cowes, Isle of Wight: Ellen MacArthur Foundation Publishing.
Weissbrod, Ilka, and Nancy M. P. Bocken. 2017. "Developing sustainable business experimentation capability—A case study." *Journal of Cleaner Production* 142 (4): 2663–76.
Wells, Peter. 2016. "Economies of scale versus small is beautiful: A business model approach based on architecture, principles and components in the beer industry." *Organization & Environment* 29 (1): 36–52.
WWF. 2016. *Living planet report 2016: Summary*. Gland, Switzerland. Accessed May 5, 2018. http://awsassets.panda.org/downloads/lpr_living_planet_report_2016_summary.pdf.
Yin, Robert K. 2014. *Case study research: Design and methods*, 5th ed. Thousand Oaks: SAGE.
Zollo, Maurizio, Carmelo Cennamo, and Kerstin Neumann. 2013. "Beyond what and why: Understanding organizational evolution towards sustainable enterprise models." *Organization & Environment* 26 (3): 241–59.

6

Business-Driven Ecological Innovations in Green Growth Strategies

Jan Engelmann and Mohammad Al-Saidi

Introduction

Green growth and green economy are two key terms that describe a recent sustainability paradigm aimed at linking growth in the private sector with addressing increasing environmental problems and the minimisation of its impact on the ecosystem. Through so-called ecological innovations (eco-innovations), a win-win situation of both job creation (and hence growth) and environmental protection can be achieved. While green growth has been criticised for being a repackaging, or a

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green-washing, of (old) neoliberal ideas, the novelty and merits of the concept can be highlighted by relating it to the envisioned business models and innovations behind it. Concepts such as green growth and eco-innovations are closely related, while the link between the two is poorly understood. In fact, both ideas reflect the increasing demand for alternatives to the business-as-usual growth path. Such a path fails to effectively combat challenges of resource depletion, rising carbon emissions, destruction of ecosystems and environmental disasters. If businesses do not change the current path, 5–10% of the global GDP could be lost annually due to the climate change impacts alone, especially in developing countries (Stern 2007).

Green growth offers a compromise between growth and sustainability. At the same time, the concept of eco-innovation takes a central role in the current green growth debates, since technological and organisational innovations can help save resources and lower negative impacts of production and consumption. In this chapter, we analyse this link between green economy and business-driven eco-innovations in order to clarify prerequisites and demands on businesses that seek to drive the change towards a more balanced and sustainable growth pathway. In fact, green growth is a controversial term which is understood in widely varying ways, while eco-innovation serves as a concretisation of the means of achieving it. Similarly, green growth is often seen as an operationalisation strategy of the overarching paradigm of sustainable development (UNESCAP 2012; OECD 2011a). At the same time, green growth has many interlinkages with other paradigms and sub-concepts (Loiseau et al. 2016), and other related principles and concepts (e.g. circular economy, decoupling, strong or sustainable development reflected in the Sustainable Development Goals (SDGs)), as we discuss in this chapter.

The debate about the concepts of green growth and green economy will be presented, with eco-innovations and sustainable business models as the pragmatic core of green growth debates. Here, the assessment of business models and certain industries with regard to their potential of embodying the green eco-innovation and growth idea is explained. Building on this, we recommend how public policies and adequate regulations can incentivise and promote business-driven eco-innovations.

Emergence of Green Growth in Environmental Policy

As global challenges of resource depletion, climate change and environmental pollution further threaten human well-being, the environment and economies, new growth paradigms have evolved in the international arena to offer alternative pathways for our economic systems. Green growth and green economy are two important and much-debated concepts of today. In the aftermath of the global financial crisis of 2008, green growth attracted significant attention towards the environment as a motor for growth, attracting new investment opportunities and establishing new industries that are in line with the idea of sustainability (Jacobs 2012). The basic idea of green growth lies in the harmonisation of economic growth with environmental sustainability (Kwon 2010). The concept was also a key theme of the Rio+20 conference in 2012, which spawned many initiatives aimed at mainstreaming green growth into national strategies. Since then, several governments around the globe have adopted green growth/green economy as a guiding principle for their economies (Megwai et al. 2016).

In fact, green growth and green economy are closely related, and the terms are often used interchangeably. Often, green economy is a term used to describe the result or output of the process of green growth. Essentially, green economy is one that is characterised by green growth processes. Both terms put the economy at the centre of attention, while the potential for innovation plays a crucial role (Jänicke 2012). Business-driven eco-innovations as an instrument for economic growth therefore represent the pragmatic core of the green economy and will thus be analysed in this chapter.

Green growth and green economy are sometimes negatively reviewed for their overemphasis on the role of businesses and also for presumed conceptual ambiguities. In fact, there is rich debate on the contents and merits of this concept; for example, green growth is criticised for "repackaging of sustainability" (Gupta 2014) or even trying to replace it. In contrast, the Organisation for Economic Cooperation and Development (OECD) sees it not as a replacement for sustainable development, but rather a subset of it, entailing an "operational policy agenda" at the intersect of economy and environment, as well as promoting "conditions for innovation, investment and competition" (OECD 2011a) to achieve growth in harmony with ecological considerations. On the other hand, critics of green growth note that the concept neglects the social dimension and limits its effect on poverty reduction. In this regard, Hallegatte et al. (2011) recognise the emphasis of green growth on the economic and environmental dimensions, while pointing out significant improvements in people's lives, e.g. through job creation or improved water quality. In fact, if one looks at some famous definitions as summarised in Table 6.1, the economy–environment emphasis is clear despite some definitions incorporating social inclusiveness or equity. Jänicke (2012) and Boström (2012) explain the negligence of social dimensions, *inter alia* due to practical reasons, because international experience so far has revealed difficulties in realising and operationalising the social dimension in growth. Table 6.1 summarises the definitions of key institutions that are leading the debate on green growth.

The promotion of green growth has created a new momentum in the debate about pathways towards economic development, which also fulfils the environmental dimension of sustainability (Jacobs 2012). With this in mind, green growth promises to help concretise and operationalise national policies towards a sustainable development pathway. So far, a large volume of literature has focused on defining green growth (Jacobs 2012; World Bank 2012; Livermore 2014) and identifying the potentials of green growth either in general (OECD 2011a; UNEP 2011), or for a specific country (MoEnv and UNEP 2011; GGGI 2013). Current green growth research initiatives and projects mostly deal with questions of technology and innovation, sustainable economic growth, green jobs and metrics to measure green growth performance. In pursuit of this, many institutions have put forward metrics and indicators to operationalise this idea. For example, the OECD has issued several publications on how to measure green growth and developed tools to deliver green growth (OECD 2011b). One of them is "Green Growth Diagnostics", which is a modified version of "Growth Diagnostics" by Hausmann, Velasco and Rodrick (2004).

Table 6.1 Green growth definitions of leading key institutions

Definition	Source	Focus
"…fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies"	OECD (2011a): Towards Green Growth	A highly cited definition emphasising the economy–environment link
"Green economy is one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities In its simplest expression, a green economy is low-carbon, resource-efficient and socially inclusive"	United Nations Environment Programme (UNEP) (2011): Towards Green Economy	Probably the most comprehensive definition, with instrumental novelty of the concept (low-carbon, efficiency, risks)
"…an implementing strategy to achieve sustainable development that focuses on improving the eco-efficiency of production and consumption and promoting a green economy, in which economic prosperity materializes in tandem with ecological sustainability"	United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (2012): Low Carbon Green Growth Roadmap for Asia and the Pacific	Definition of green economy as a part of sustainable development and in relation to other concepts
"…growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters"	World Bank (2012): Inclusive Green Growth	A definition through characterisation of the growth process, while adding the factor of resilience against natural hazards
"Green growth is the new revolutionary development paradigm that sustains economic growth while at the same time ensuring climatic and environmental sustainability"	Global Green Growth Institute (GGGI 2013)	Similar to the OECD's definition, while emphasising its novelty

It is a methodology for diagnosing the key binding constraints to green growth in order to derive policy priorities. Sander (2011) questions the use and usefulness of this method being applied on the economy-wide level and proposes rather to apply it at the industry level and to specific environmental challenges. He shows its application using the example of the Chinese energy sector. Pueyo et al. (2015) conducted a research project in which they applied the Green Growth Diagnostics methodology in Ghana and Kenya to identify the binding constraints to private investment in clean energy. Another example of measurement of green growth performance is the "Global Green Economy Index (GGEI)", published by Dual Citizen (2016), which investigates four key dimensions: leadership and climate change, efficiency sectors, markets and investment, and the environment. A pioneering actor in terms of water and green growth is the Republic of Korea, which works in partnership with the World Water Council (WWC) on the "Water and Green Growth Project". They developed the "Water and Green Growth Index" (WGGI), which offers a variety of environmental, economic and social indicators evaluating the extent to which a country is committed to water and green growth (MLTM et al. 2012). However, the index was not applied to other countries, but rather examined the policies and framework for water and green growth.

The Role of Business-Driven Eco-Innovations

Eco-Innovations as a Growth Strategy

Eco-innovations play a crucial role in green economy concepts in terms of practical and conceptual operationalisation. This is demonstrated by analysing the contents of green growth debates in this section and introducing the contribution of eco-innovation in implementing concrete green growth strategies in the next part. We first reviewed key publications in order to identify key principles and concepts that describe the underlying content of green growth. In doing so, we based our definitions on the Prognos (2014) classification of concepts associated with green growth. Green growth can thus be understood as a purposeful paradigm (political initiative) to promote industries and business models that represent viable eco-innovations, and effectively decouple resource use from economic growth (strategies) in order to contribute to a sustainable, low-carbon economy (economic system view). Figure 6.1 shows these three constituent elements, along with our own understanding of green growth.

Firstly, the economic view of green growth is often related to attributions of a future state or the economy being "green", "low carbon" or "circular". In this regard, "green economy" is a general attribution, while "low-carbon economy" refers to economic production with low (or no) carbon emissions, e.g. by using renewable energies instead of fossil fuels. Reducing carbon emissions is a critical step towards minimising the output of greenhouse gas (GHG) emissions into the biosphere, which are the main cause of global warming (hence climate change), as shown by Pachauri et al. (2014). Lowering of the carbon impact of economic production is a crucial parameter when it comes to green growth. In line with the Paris Agreement to limit global warming to well below 2 °C in this century, reducing the carbon footprint in the countries' economies is essential for growth that is not damaging to the

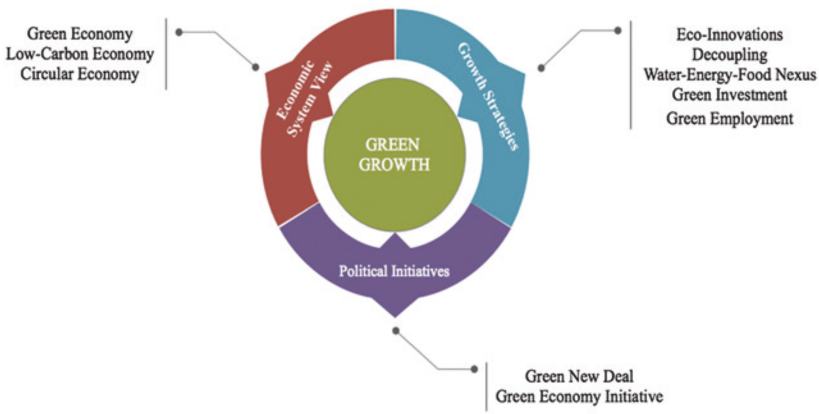

Fig. 6.1 Concepts and principles related to green growth (author's illustration, based on Prognos 2014)

environment or the climate. Low-carbon strategies are also important for specific sectors such as the water sector, which consumes a lot of energy for extraction, desalination treatment, and pumping of water over long distances and elevations (Copeland and Carter 2017). On the other hand, the circular economy concept implies sustainability by using the biological and technical materials from one production or consumption process and circulating it as an input into the same or a different process (UNEP 2006). In other words, it emphasises the most efficient use and recycling of resources in order to protect the environment.

Secondly, green growth can be characterised through associated political or policy-related initiatives. In recent years, several sustainability initiatives have been launched, with organisations such as the United Nations playing a decisive role in this process. For example, the Global Green New Deal emerged with the growing acknowledgement of climate change impacts and the finite nature of oil resources. First introduced by Thomas L. Friedman, in 2008, the UNEP began to popularise the initiative, which calls on governments to turn the crises of the financial and economic systems into an economic opportunity by investing in the green sector to create jobs, promote sustainable and inclusive growth, and achieve the Millennium Development Goals (MDGs) (UNEP 2009). Subsequently, various governments, such as the EU and the Republic of Korea, have invested a majority of their funds in green measures. Closely related is the Green Economy Initiative (GEI), also led by UNEP, which was acknowledged as a tool for achieving sustainable development at the Rio+20 agenda in 2012. The initiative is designed to assist governments in "greening" their economies by reshaping policies and investments in green sectors and technologies, such as renewable energies, water services or waste management. Recently, the notion of "inclusiveness" was emphasised with the aim of ensuring social equity in the GEI process. So far, 65 countries have embarked on the pathway towards a green economy, and 45 have already developed national green economy plans (UNEP 2014). At the same time, green economy can itself be seen as part of a larger political initiative or of broader policies for sustainable development. For example, green growth is embedded in the new sustainable development agenda, in the guise of the SDGs. Arguably, it is mainly manifested in Goal 8, "Decent Work and Economic Growth", and specifically in its Target 8.4, "to ensure global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation". Furthermore, it is implicitly reflected in a number of other goals, e.g. Goal 6: Clean Water and Sanitation; and Goal 7: Affordable and Clean Energy.

Finally, green growth can be seen as a term describing a set of growth strategies. The promotion of eco-innovations represents the most prominent growth strategy in this regard, as we explain in the next section. Another related, although more general, strategy is represented by the notion of decoupling resource use from growth. Through such decoupling, economies can continue to grow, while the environmental pressures on natural resource use are decreased (IRP 2015). Decoupling can happen in two ways, as a number of success stories in the water sector have demonstrated (MLTM et al. 2012). On the one hand, it can be achieved through relative decoupling, which means a decrease of resource use per unit of value added. On the other hand, absolute decoupling indicates a decline of resource use or environmental impact, irrespective of the growth rate of the economy. Another prominent topic linked to green growth strategies is the Water–Energy–Food Nexus (WEF Nexus). The WEF Nexus debate can be seen as the newest integrated management paradigm in environmental sciences, and centres around the analysis of the links between the three resources in order to identify opportunities to increase sustainability, encourage resource-efficient growth and minimise impacts (Al-Saidi and Elagib 2017). Furthermore, green investment and green employment represent generic strategies for achieving green growth. Green investment aims at financing companies or productions that have a positive impact on the environment, e.g. by conserving natural resources. Green employment focuses on growth and job creation. Green growth should not only reduce emissions and resource use, but should also stimulate creation of new jobs for the people. Such jobs are characterised as "green jobs" since they contribute to the preservation and restoration of the environment in sectors such as manufacturing and construction or emerging green sectors such as renewable energy and energy efficiency.

Eco-Innovations, Resource Efficiency and Business Models

The development and utilisation of eco-innovations play a crucial role in enabling green growth through industries and businesses and is perceived as one of the main tools for the transition to a green economy (Tarnawska 2013; Beltramello et al. 2013; Sander 2011). The concept of eco-innovations outdates the rise of the green concepts. Eco-innovations are famously understood as invention of new—or optimised—technology, and also the improvement of processes or business models that lead to environmental benefits, such as resource conservation or reuse along the value chain (OECD 2009). Eco-innovations are thus innovative products and processes that aim at reducing impacts on the environment, strengthening resilience to environmental pressures or achieving a more efficient and responsible use of natural resources (European Commission 2012). They cover everything from technological improvements in resource efficiency to societal innovations (Sander 2011). Utilisation of eco-innovation is a central and constituent element of green growth, since it is difficult to fulfil the other criteria if eco-innovations are not utilised. Industries and businesses stand at the core of economic activity and need to incorporate green growth in their value chains. Green growth thus implies establishing and promoting new industries that go hand in hand with the idea of sustainability, resource efficiency and decoupling (UNDESA 2013). It is important to note that eco-innovation need not only be of a technological nature, but can also entail process innovations, such as introducing new product lifecycles. Essentially, it is through business models that incorporate eco-innovations that we achieve resource efficiency and ultimately decoupling. The principle of resource efficiency is recurrent in green growth literature and is often linked to technological and methodological innovations (Beltramello et al. 2013; UNESCAP 2012; OECD 2011a; World Bank 2012). Resource efficiency means the most optimised way of using resources for production, with the ultimate aim of decoupling economic growth from resource use (IRP 2015). Decoupling is therefore the ultimate goal of increased resource efficiency and utilisation of eco-innovation and is thus referring to future state growth under the green growth paradigm.

In academic case study literature, there are numerus examples of business-driven eco-innovations with promising potential in fields of water efficiency, renewable energy use or recycling processes. Levidow et al. (2016) investigate eco-innovation potential for two manufacturing companies with strong prospects for improvement in water-service processes, especially from wastewater and chemical inputs. Campana et al. (2015) evaluate the use of photovoltaic water pumping systems for irrigation as a means of promoting farmland conservation in China. Furthermore, Mezher et al. (2011) review and assess different desalination technologies with regard to their energy requirement, water production cost and environmental impact; while Fam and Mitchell (2013) investigate nutrient recovery and reuse potentials of wastewater treatment technology.

All in all, these eco-innovations represent viable solutions to minimising environmental impacts, increasing process efficiency and ultimately supporting green growth strategies.

Public Policies for the Promotion of Eco-Innovations

Green growth is being translated into national and sectoral strategies in many parts of the world in industrial and developing countries alike. The utilisation of eco-innovations hereby plays a crucial role in implementing green growth plans. The European Commission has adopted a plan to enhance sustainable growth and pave the way for Europe to transition towards a green economy. The Eco-Innovation Action Plan within the Europe 2020 framework was issued in order to boost innovations that reduce environmental pressures and to enable more efficient production for European industries (Triguero et al. 2013). Looking at developing countries, Ethiopia, as one of the first African countries, adopted a climate-resilient green economy strategy in 2011 which aims at increasing agricultural productivity, strengthening the industry and fostering export growth while mitigating emissions (Megwai et al.

2016). The strategy emphasises that opportunities for innovation, based on the latest production platforms, need to be seized in order to facilitate leapfrogging to the newest and best technology (FDRE 2011). Jordan also released its own National Green Growth Plan (NGGP) in 2017 to further develop its economy, lessen the dependence on energy imports, and create decent jobs. The NGGP contains a policy framework and capacity development activities in six key sectors, with a specific focus on upscaling opportunities and financing mechanisms. Stimulation of innovation and investment by the private sector in new and adaptive technologies and through innovative business models is a declared target of the strategy (MoEnv 2017).

As a practical example, the wastewater treatment industry in Jordan shows how technological innovation that is promoted by a supporting policy framework has significantly contributed to reducing water stress, avoiding environmental contamination and creating new opportunities for employment and business expansion. Modern technologies for treating wastewater were introduced in Jordan in the late 1960s and have increased the amount of wastewater reused in irrigation or industries to 125 million m^3 in 2014 (MWI 2016). Governmental policies allowed for a progressing reuse of treated wastewater and are also found in the NGGP. New ecological innovations in decentralised treatment technologies, such as systems that recycle nutrients and produce bio-energy onsite, represent attractive and viable opportunities for businesses to expand wastewater treatment services to remote places and apply scalable options to each given context.

The examples above underline that governments have several policy options for incentivising the utilisation of eco-innovations. As shown by Demirel and Kesidou (2011), government-induced regulations help to raise environmental awareness and drive the implementation of “end of pipeline” technologies. Another policy option is “getting research to the market” (Kemp 2011) which means comprehensive R&D support (e.g. subsidies) and technology transfer (e.g. through partnerships and networks). Moreover, environmental tax reform and market-based policies, including tradeable permits, can create important incentives for improving the productivity of natural resources (Sarkar 2013).

Conclusion

Green growth is a contemporary strategy for sustainable development that encompasses a conceptual economic perspective, concrete growth strategies and political initiatives linking economy to environment. Eco-innovations hereby play a crucial role as one of the main tools for enabling a transition to a green economy and are therefore a central and constituent element of green growth. Specifically, eco-innovations represent the key strategy for achieving green growth through incentivising businesses creating economically viable and environmental sound solutions.

In summary, innovative businesses are the important actors that incorporate eco-innovations and spread their use to achieve resource efficiency and eventual decoupling. The adoption of such innovations on a wide scale is seen as a criterion for assessing businesses and industries that bear a great potential for supporting green growth. Many countries worldwide have already started developing green growth strategies, with concrete incentives such as pricing reforms, subsidisation and entrepreneurship programmes aimed at priority industries with high potential for green growth. This prioritisation of economically viable and environmentally sound business solutions should also be examined with regard to the viability of addressing social issues. Eco-innovations represent a strategic growth option for many countries with large ecological footprints and/or declining resource bases. However, particularly in the context of developing countries, affordability of products and services as well as the impacts of sustainability transition on "less innovative" businesses are important considerations for public policies. Often, governments choose to incorporate social welfare spillovers and distributional issues as additional criteria for their support of green and innovative industries.

To conclude, the transition towards green economy cannot take place without innovative businesses and a strong public engagement in readjusting priorities and designing incentives. Such transition provides opportunities for existing and new companies in adopting innovations that produce a win-win situation in an ecological and economic sense or capitalise on growth potential in emerging sectors. Technological change and changing public policies produce these opportunities and direct them towards societal goals such as economic growth, reducing ecological footprints, environmental protection or social considerations. (Eco-)innovations imply fundamental changes to the status-quo that are essentially local and driven by businesses exhibiting higher innovation capabilities across the whole production value chain. Yet, creating the enablers of green growth is a crosscutting task that entails, for example, R&D investments, company-level innovation incentives, collaborations between research and industry, adequate regulatory frameworks or specific innovation programmes.

References

Al-Saidi, Mohammad, and Nadir Ahmed Elagib. 2017. "Towards understanding the integrative approach of the water, energy and food nexus." *Science of the Total Environment* 574: 1131–39.

Beltramello, Andrea, Linda Haie-Fayle, and Dirk Pilat. 2013. "Why new business models matter for green growth." *OECD Green Growth Papers* 2013–01. Paris: OECD Publishing.

Boström, Magnus. 2012. "A missing pillar? Challenges in theorizing and practicing social sustainability: Introduction to the special issue." S*ustainability: Science, Practice, and Policy* 8 (1): 3–14.

Campana, Pietro Elia, Hailong Li, J. Zhang, R. Zhang, Jiahong Liu, and Jinyue Yan. 2015. "Economic optimization of photovoltaic water pumping systems for irrigation." *Energy Conversion and Management* 95: 32–41.

Copeland, Claudia, and Nicole T. Carter. 2017. "Energy–water nexus: The water sector's energy use." *Congressional Research Service*. January 24.

Demirel, Pelin, and Effie Kesidou. 2011. "Stimulating different types of eco-innovation in the UK: Government policies and firm motivations." *Ecological Economics* 70 (8): 1546–57.

Dual Citizen. 2016. *The global green economy index 2016. Measuring National Performance in the Green Economy*, 5th ed. Washington, DC: Dual Citizen.

European Commission. 2012. *Eco-innovation—The key to Europe's future competitiveness*. Brussels: European Commission.

Fam, Dena, and Cynthia A. Mitchell. 2013. "Sustainable innovation in wastewater management: Lessons for nutrient recovery and reuse." *Local Environment* 18 (7): 769–80.

FDRE. 2011. *Ethiopia's climate-resilient green economy: Green economy strategy*. Addis Ababa: Federal Democratic Republic of Ethiopia.

GGGI. 2013. *National green growth plan for ethiopia and three other Countries*. Country Selection Project (Component 2). Seoul: Global Green Growth Institute.

Gupta, Joyeeta. 2014. *The history of global climate governance*. Cambridge: Cambridge University Press.

Hallegatte, Stéphane, Geoffrey Heal, Marianne Fay and David Treguer. 2011. "From growth to green growth." *Policy Research Working Paper*. Washington, DC: The World Bank.

Hausmann, Ricardo, Andrés Velasco, and Dani Rodrik. 2004. "Growth diagnostics." In *The Washington consensus reconsidered: Towards a new global governance*, edited by Stiglitz, Joseph and Narcis Serra. Oxford: Oxford University Press.

IRP. 2015. *Options for decoupling economic growth from water use and pollution*. A report of the Water Working Group of the International Resource Panel, Paris.

Jacobs, Michael. 2012. "Green growth: Economic theory and political discourse." In *Handbook of global climate and environmental policy*, edited by Robert Falkner. Oxford: Wiley-Blackwell.

Jänicke, Martin. 2012. "'Green growth': From a growing eco-industry to economic sustainability." *Energy Policy* 48: 13–21.

Kemp, Rene. 2011. "Ten themes for eco-innovation policies in Europe." *Surveys and Perspectives Integrating Environment and Society* 4 (2): 1–20.

Kwon, Hyuk Kihl. 2010. "A complex adaptive systems approach for the green growth." In *Proceedings of the 54th annual meeting of the ISSS-2010*, 54 (1), Waterloo, Canada, Sonoma.

Levidow, Les, Palle Lindgaard-Jorgensen, Asa Nilsson, and Sara Alongi Skenhall. 2016. "Process eco-innovation: Assessing meso-level eco-efficiency in industrial water-service systems." *Journal of Cleaner Production* 110: 54–65.

Livermore, Michael A. 2014. "The meaning of green growth." *Public Law and Legal Theory Research Paper Series* 2014–12, University of Virginia School of Law.

Loiseau, Eleonore, Laura Saikku, Riina Antikainen, Nils Droste, Bernd Hansjurgens, Kati Pitkänen, Pekka Leskinen, Peter Kuikman, and Marianne

Thomsen. 2016. "Green economy and related concepts: An overview." *Journal of Cleaner Production* 139: 361–71.

Megwai, Godswill, Ndey Isatou Njie, and Tobias E. Richards. 2016. "Exploring green economy strategies and policies in developing countries." *International Journal of Green Economics* 10 (3/4): 338–57.

Mezher, Toufic, Hassan Fath, Zeina Abbas, and Arslan Khaled. 2011. "Techno-economic assessment and environmental impacts of desalination technologies." *Desalination* 266 (1–3): 263–73.

MLTM, PCGG, K-Water Institute, and WWC. 2012. *Water and green growth*, 1st ed. Korean Ministry of Land, Transport and Maritime Affairs, Presidential Committee on Green Growth, Korea Water Resources Corporation, World Water Council, Seoul.

MoEnv. 2017. *A national green growth plan for Jordan*. Amman: Ministry of Environment.

MoEnv and UNEP. 2011. *Towards a green economy in Jordan: A scoping study*. Amman: Ministry of Environment, United Nations Environment Programme.

MWI. 2016. *Water substitution and reuse policy*. Amman: Ministry of Water and Irrigation.

OECD. 2009. *Eco-innovation in industry*: *Enabling green growth*. Paris: Organisation for Economic Cooperation and Development.

OECD. 2011a. *Towards green growth*. Paris: Organisation for Economic Cooperation and Development.

OECD. 2011b. *Tools for delivering on green growth*. Paris: Organisation for Economic Cooperation and Development.

Pachauri, Rajendra K., Myles R. Allen, Vicente R. Barros, John Broome, Wolfgang Cramer, Renate Christ, and John A. Church et al. 2014. *Climate change 2014: Synthesis report. Contribution of working groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change*, IPCC.

Prognos. 2014. *Analyse von Konzepten zu "Green Growth."* Basel: Endbericht.

Pueyo, Ana, Stephen Spratt, Hubert Schmitz, Dirk Willenbockel, Chris Dent, Neal Wade, and Andrew Crossland. 2015. "Green growth diagnostics for Africa: Literature review and scoping study." *IDS Working Paper 455*. Brighton: Institute of Development Studies.

Sander, Harald. 2011. "The use and usefulness of OECD's 'green growth diagnostics.'" *Globus Working Paper No. 2011/3*.

Sarkar, A. N. 2013. "Promoting eco-innovations to leverage sustainable development of eco-industry and green growth." *European Journal of Sustainable Development* 2 (1): 171–224.

Stern, Nicholas. 2007. *The economics of climate change: The Stern Review*. Cambridge, UK: Cambridge University Press.

Tarnawska, Katarzyna. 2013. "Eco-innovations—Tools for the transition to green economy." *Economics and Management* 18 (4): 735–43.

Triguero, Angela, Lourdes Moreno-Mondéjar, and Maria A. Davia. 2013. "Drivers of different types of eco-innovation in European SMEs." *Ecological Economics* 92: 25–33.

UNDESA. 2013. *A guidebook to the green economy: Issue 4: A guide to international green economy initiatives*. New York: United Nations Division for Sustainable Development.

UNEP. 2006. *Circular economy: An alternative model for economic development*. Paris: United Nations Environment Programme.

UNEP. 2009. *Global green new deal: An update for the G20 Pittsburgh summit*. Paris: United Nations Environment Programme.

UNEP. 2011. *Towards a green economy: Pathways to sustainable development and poverty eradication*. Nairobi: United Nations Environment Programme.

UNEP. 2014. *Towards a greener and more inclusive economy*. Nairobi: United Nations Environment Programme.

UNESCAP. 2012. *Low carbon green growth roadmap for Asia and the Pacific: Turning resource constraints and the climate crisis into economic growth opportunities*. Bangkok: United Nations Economic and Social Commission for Asia and the Pacific.

World Bank. 2012. *Inclusive green growth: The pathway to sustainable development*. Washington, DC: World Bank Publications.

Part II

Strategy and Leadership for a Sustainability Transition

New Business Models to Make Fashion More Sustainable

Let us tell you a little more about the fashion industry. It's the second most polluting, only after oil. Even more staggering is the way we as humans evolved. We consume 400% more clothing today compared to 20 years ago, and the average garment is only worn seven times before it gets thrown out. Overconsumption and the disposal of unwanted clothing has become a global problem. A circular economy could be part of the solution. At MUD Jeans, we take the most popular fashion item, a pair of jeans, and make these in a way to be recycled after use. Apart from discarding leather labels (100% vegan), MUD Jeans introduced the innovative concept "Lease A Jeans". Customers can rent their denim through the Lease programme and pay a one-off membership fee of €29,- and then €7,50 a month. After a year, customers can keep the jeans or swap them for a new pair, continuing paying the monthly fee.

When we introduced the lease model in 2013, it was big news. The Guardian, the Wall Street Journal, The Huffington Post, they all wrote about this small Dutch company turning the circular economy into a brand building experience. A few years ago, we already reconsidered how fashion should be produced and how it could be consumed.

Production-wise this is way more challenging than a traditional clothing company; we had to really think through our waste streams, logistics, design process and recycle process. But since the circular economy is in our DNA this is what we do. Consumption-wise we had to encourage consumers to change their shopping behaviour. Leasing a product requires a different mindset; the relationship to a brand no longer ends as soon as the purchase is complete.

While we are slowly building a community of like-minded people that search for brands that stand for something bigger than just the product, we suddenly noticed an increase in the number of people that want to change their lifestyles; fewer material possessions but more meaningful experiences that help them live better. Millennials in particular are seeking out this minimalist lifestyle. This group marks a quarter of the population and the majority of the workforce.

Team MUD always kept on the positive side, being creative with small budgets, focusing on storytelling and its trans-seasonal collection. The simple lesson learned; keep believing in your mission. Don't change it. Even though others may think you're trying to accomplish the impossible!

By Bert van Son & Danique Gunnink, MUD Jeans

7

Leadership, Innovation, and Sustainability

Robert Verburg

Introduction

Understanding the need for long-term survival and competitiveness at different levels in society, a growing number of organizations aims for sustainability. This implies the creation, delivery, and capturing of all three dimensions of value (economic, social, and environmental) as part of their business model (e.g., Boons et al. 2013; Bocken et al. 2014; Lüdeke-Freund et al. 2016). Innovation is an important means to achieve sustainability and relates to the development of new products and services, processes (production methods and procedures), technologies, organizational practices, and business models. Innovation is vital for organizational survival and constitutes a significant source of competitive advantage for organizations (Teece 2010; Gunday et al. 2011).

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As a field of inquiry, innovation is broad and distinctions can be made between the diffusion and adoption of innovations in the market versus organizational innovating and innovativeness. Here, we regard innovation as a process of turning opportunity into new ideas and of putting these into widely used practice (Tidd et al. 2005). Firms increasingly aim for sustainability-oriented innovation, rather than innovation as a solely profit-oriented pursuit (Adams et al. 2016). Here, we refer to sustainable innovation as both a process and an outcome of pursuits that increase economical, ecological, and social aspects of value creation (Inigo and Albareda 2016). Such innovation is all but easy and leadership seems to be an important driver of this kind of value creation (e.g., Visser 2018). Although some claim that the challenges in relation to sustainable innovation call for a specific kind of leadership, the overall concept of sustainability leadership seems to be plagued by inconsistencies in the way it is conceptualized, studied, and presented.

The aim of this chapter is to further understanding around the leadership challenges associated with sustainable innovation. Leadership is defined as the process by which a leader influences others in ways that help attain group or organizational goals (Yukl 2012) and features as an important predictor in many studies on organizational success. In this chapter, the focus is on formal leadership roles within organizations, and not specifically on leaders of sustainability movements (see, e.g., Johnston 2014). We also do not focus on individuals within organizations trying to exert upward influence in putting sustainability on the leadership agenda, a proactive employee behavior more generally known as 'issue selling' (see, e.g., Dutton et al. 2001). The chapter is structured as follows. First, the link between leadership and innovation will be highlighted and next the nature of sustainable innovation will be discussed before I explore whether there is something called *sustainability leadership*.

Leadership Perspectives and Innovation

The urge for organizations to keep innovating implies encouraging creativity in order to stimulate both the generation and implementation of new ideas (Teece 2010; Gilson et al. 2005). Creativity is traditionally defined as the production of novel and useful ideas (Amabile et al. 1996) and is often associated with individuals, whereas innovation tends to be accomplished by groups, organizations, or societies (West 2002). Montag et al. (2012) show that behaviors driving creative processes are an integral part of the role of R&D professionals. The emphasis on innovation and creativity has a profound impact on the way organizations lead their teams as command and control does not fit well with offering employees the freedom to explore. Therefore, leadership is increasingly regarded as an important predictor of innovation outcomes (Rosing et al. 2011).

Although innovation and creativity are very important areas of inquiry, the empirical research on leadership and innovation is surprisingly limited (see Anderson et al. 2014 for an overview). Only a small percentage of leadership studies were conducted in R&D organizations or other contexts in which creativity and innovation outcomes are central performance indicators (e.g., De Jong and Den Hartog 2010; Gupta and Singh 2015). Research evidence, so far, suggests a link between leadership and innovation outcomes in organizations. More particularly, studies suggest that a transformational leadership style may help stimulate innovative behavior in areas in which creative engagement is important (Rosing et al. 2011).

Transformational Leadership, Innovation, and Sustainability

Transformational leadership is characterized by the use of idealized influence (charisma), inspiration, intellectual stimulation, or individualized consideration in order to move followers beyond immediate self-interests and motivate them to contribute to the goals of the collective (Bass 1999). Before researchers addressed the role of transformational leadership, studying leadership performance used to focus on the characteristics (or traits) of leaders or their behaviors to facilitate group maintenance and ensure task accomplishment. When transformational leadership became more central, the role of leaders providing a vision or overarching goal was added to the agenda. For leaders, a well-articulated and attractive vision or sense of direction is crucial to integrate and align followers' efforts.

The sense of purpose that an attractive vision of the future inspires, acts as a powerful motivating force for those who share this vision.

Vision is what contrasts transformational leadership with other forms of leadership such as transactional forms of leader behavior (Bass 1999). Transactional leadership views leader–follower interactions from an exchange perspective. An effective transactional leader recognizes what followers want to get from their work and tries to see that they are rewarded with their desired outcomes if their performance warrants it. The leader clarifies performance criteria, rewards meeting these criteria, and takes action when correction is needed. As such, a transactional leadership style can be effective in driving short-term meeting of performance targets, but is not likely to be associated with innovation and creativity as experimentation is not encouraged (Rosing et al. 2011). Also, the effect of formal control on performance seems to be much stronger in stable and standardized environments, than in knowledge-intensive firms. For example, Horwitz et al. (2003) argue that knowledge-intensive organizations are usually more decentralized, networked, and flatter than traditional firms and therefore rely more on normative kinds of control than on common command and control arrangements (Alvesson 2000).

Transformational leaders go beyond such cost-benefit exchanges and both inspire and challenge followers to make the vision a reality (Bass 1999). The dynamics of transformational leadership involve joining in a shared vision of the future and going beyond the self-interest exchange of rewards for compliance (Bass 1999). By defining the need for change and creating a new vision the leader can help followers see new possibilities. Such leaders also stimulate followers to think outside the box and try out new ideas or work methods if these would help to realize the vision.

Transformational leadership is a proactive rather than a reactive way to lead. Earlier leadership models focused on how follower needs and other contextual conditions determine leaders' actions and leaders were mostly seen as effective when they reacted effectively and thus complemented the environment. Transformational leadership models describe how leaders proactively change their environment and emphasize how they create desirable conditions and affect change rather than merely respond to followers or the context. Transformational leaders (when compared to transactional leaders) have subordinates reporting greater satisfaction, motivation, trust, and commitment. Such leaders also receive higher ratings of effectiveness and performance and have higher performing business units (see, e.g., the early findings by Fiol et al. 1999).

In a review of more than 30 well-established empirical studies on the link between transformational leadership and innovation, Rosing et al. (2011) show that transformational leadership correlates positively with several innovation outcomes in organizations. They argue that it is plausible to expect such a positive relationship because transformational leadership enhances follower motivation and passion for the vision and may also encourage followers to try new things and challenge the status quo rather than to automatically march in line with management. Rosing and her colleagues warn, however, that it is insufficient to focus on the main effect of transformational leadership on innovation only as there are strong variations in the results of the different studies and the organizational context may affect how effective such leadership is. Nevertheless, the results of their meta-analysis suggest a strong relationship between transformational leadership style and innovation outcomes in organizations.

Ethical Dimensions of Leadership

In the last few years, concepts such as integrity, responsibility, and ethics have prominently entered the field of leadership studies. Focusing on this ethical dimension of leadership has gained popularity following the many infamous cases of ethical misconduct by CEOs, such as Kenneth Lay (Enron), Conrad Black (Hollinger International), and Scott Thompson (Yahoo!) as well as ethical lapses of leaders beyond the business arena. In older work, transformational leadership was described as containing an ethical component, but more recently authors indicate such leaders may have more or less ethical aims and there has been an increased attention for ethical behaviors of leaders more generally (Den Hartog 2015). Studying the ethical dimensions of leadership is not new (see for instance Kanungo and Mendonca 1996) and there are many different perspectives which highlight the ethical dimensions of leadership, such as ethical, authentic, spiritual, and servant leadership[1] (see Table 7.1).

Table 7.1 Different leadership perspectives which highlight moral/ethical dimensions

Leadership type	Focus	Main source
Transformational leadership	The use of idealized influence (charisma), inspiration, intellectual stimulation, or individualized consideration in order to move followers beyond immediate self-interests and motivate them to contribute to the goals of the collective	Bass (1999)
Ethical leadership	Leaders have a strong influence on ethical standards and act as ethical role models. Reward and punishment are applied in order to promote ethical behavior of followers	Treviño et al. (2003)
Spiritual leadership	Values, attitudes, and behaviors that are necessary to intrinsically motivate one's self and others so they have a sense of spiritual survival/well-being through calling and membership	Fry (2003)
Authentic leadership	A process that involves positive psychological capacities as well as a highly developed organizational context, which results in greater self-awareness and self-regulated positive behaviors on the part of leaders and associates, fostering positive self-development	Avolio and Gardner (2005)
Servant leadership	Demonstrated by empowering and developing people; by expressing humility, authenticity, interpersonal acceptance, and stewardship; and by providing direction	Van Dierendonck (2011)

While strong correlations are found between ethical and transformational leadership (as well as the other forms of leadership in Table 7.1) they do also conceptually differ (see Den Hartog 2015). Ethical leadership includes being both a focus on the leader as a moral person and as a moral manager and an ethical leader has qualities, such as honesty and trustworthiness, and tries to act fairly, showing concern for others and considering the consequences of his or her actions (e.g., Brown et al. 2005). Leaders use managerial roles and leadership positions to promote ethics in the workplace for example, through role modeling ethical conduct, setting and communicating ethical standards, and using reward/punishment to ensure that ethical standards are followed (Kalshoven et al. 2011). Kalshoven and colleagues also emphasize that ethical leaders take the effects of their behavior on their surroundings into account, including the effects on society and the natural environment. They present a measure of ethical leadership and argue that sustainable leadership as a relatively new field of inquiry is linked to this specific leadership style.

Understanding Sustainable Innovation and Leadership: A Case Illustration

While innovation is increasingly seen as a potential source of competitive advantage, as noted a growing number of organizations aim to also include social and environmental aspects in their economic value creation. Accordingly, such firms aim for sustainable innovation rather than innovation as such. Sustainability relates to the inclusion of both environmental and social concerns into the organization's business operations and its interactions with stakeholders (Van Marrewijk and Werre 2003). Sustainable businesses offer products and services that fulfill societal needs, while still contributing to the well-being of the earth's inhabitants (Christensen et al. 2007).

Here, I will provide a short illustration of a sustainable business case. For example, up to 40% of the more than 395,000 tons of bananas grown in Australia each year are dumped before they even leave the farm. Just because these bananas are not the right color, shape or size, or because of oversupply in the market. Banana farmers Krista and Rob Watkins tried to find a solution as they discovered that those unwanted green bananas could be made into a highly nutritious, gluten free flour. Since it takes 10 kilos of green bananas to make about 1 kilo of flour, peeling by hand did not prove very effective. This gave Rob Watkins the impetus to design the world's first mechanical banana peeler. As a result of these efforts, Krista and Rob Watkins founded the so-called Natural Evolution Foods company.[2]

Between their different product lines, which include gluten-free flour as well as skincare products, and a health supplement made from bananas, they save millions of bananas each year from waste. They now work together with other farmers in the area in order to ensure minimal waste and maximum profits for the community. Their success has attracted international interest and Rob and Krista have won several awards, including a Gold Edison Award, for their now world-renowned waste-reducing technology. Bananas are the fourth largest crop grown in the world and Australia only grows about 1% of the world's crop. The ambition of Natural Evolution Foods is to create more international awareness of the possibilities to use banana waste to help starvation and hunger situations globally. In order to do so, their business case serves as a source of inspiration for other business owners.

The Construction of a Sustainability Vision

The example above illustrates a successful effort in sustainable innovation. The goals of the business are to contribute to the environment by creating less waste, while helping reduce global starvation by offering nutritional alternatives and being an economically healthy organization at the same time. This certainly seems like a powerful vision for a firm that could attract and motivate both employees and customers. As the core element of transformational leadership is the articulation of an attractive vision of a possible future, such leadership if it can create visions such as the one in the example above could also be an effective style for encouraging sustainability. For instance, the vision of Natural Evolution Foods describes a better future in ideological terms, which is likely to be congruent with the dearly held values of people who are attracted to work at this firm and customers who will buy from them. Older theory suggests that leaders can instill pride, gain trust, and increase a sense of optimism and hope in followers through articulating such a vision (Shamir et al. 1993), which should also be the case for sustainable innovation.

Although transformational leadership could be an effective style for encouraging sustainability, there is no clear research evidence (yet) for this effect. Only few studies relate transformational leadership with sustainability outcomes. A notable exception is the study by Tabassi and his colleagues (2016) addressing the role of transformational leadership behavior of project managers in sustainable construction projects in Malaysia. They only found limited support for the direct relationship between transformational leadership and sustainable performance measures. Other studies which highlight the importance of stakeholders and both environmental and broader social concerns can be found in the literature on corporate social responsibility (CSR). In this realm, the empirical work by Waldman et al. (2006), who study the link between CSR and CEO transformational leadership and intellectual stimulation, is often cited.

However, CSR and sustainability are not the same, although they are not often separated in studies. CSR is often defined as 'the voluntary actions taken by a company to address economic, social, and environmental impacts of its business operations and the concerns of its principal stakeholders' (Christensen et al. 2007: 352). Like the example of Natural Evolution Foods shows, sustainability refers to business that contributes to an equitable and ecologically sustainable economy as their core mission and not so much to separate corporate social or environmental initiatives. Despite their differences CSR and sustainability are often treated as the same. For example, in a study on leader characteristics of newly appointed members of top management teams in a large sample of US firms, Wiengarten et al. (2017) interchange sustainability and CSR in the position titles of the officers and directors in their sample. Although established firms may use sustainability labels for their officers, a chief sustainability officer does not necessarily imply sustainable leadership. This starts to beg the question: Is there such a thing as 'sustainable leadership'?

Sustainable Leadership?

According to Ferdig (2007), sustainable leadership 'reflects an emerging consciousness among people who are choosing to live their lives and their organizations in ways that account for their impact on the earth, society, and the health of local and global economies' (p. 26). In this definition, leadership is regarded as taking charge by individuals in general, rather than being aimed at individuals who are responsible for a business and its people (formal leaders). The former seems more related to emergent (informal) leadership by any individual and not (as we focus on in this chapter) limited to the leadership of those in management and business ownership roles. In other words, individuals from any background taking action to create awareness about sustainability challenges in relation to the natural environment and society seem to be key in much of the sustainable leadership work to date, rather than focusing on the role of managerial leadership in sustainability and sustainable innovation. The term leadership is probably used to underline the importance of being proactive as an individual in order to pursue sustainability goals rather than to be reactive or even complacent. This is in line with the more general work on strategic proactive work behaviors that describe how employees might try to influence the organizational agenda, such as the aforementioned issue selling. The work by Parker and Collins (2010) provides an overview of more such proactive work behaviors that employees can show.

Steve Schein (2015) takes a more corporate perspective and applies the term sustainability leadership in order to present the findings of 65 interviews with what he calls 'global sustainability leaders' of multinational corporations, NGOs, and consulting firms. He presents illustrations of how such global sustainability leaders have shaped their ecological worldviews, how they express these, and how they try to influence others through their expressions. He proposes a generally more collaborative approach to leadership with less control. In line with Ferdig (2007) he also emphasizes the importance of collective wisdom. His book relates to the nature and importance of ecological worldviews and contains a number of remarkable examples of leadership within the context of sustainability; however, his analysis does not reveal new insights that go above or beyond the current theoretical understanding of how leaders influence others in times of change in organizations or society.

In another qualitative study, Quinn and Dalton (2009) focus on leadership associated with the introduction of sustainability initiatives by 17 leaders in 12 organizations in the USA. They argue that sustainability leadership is not particularly different from other effective leadership behaviors in relation to change efforts. A vision must be formulated in a compelling way and must be integrated into the business so that employees may be engaged through this. However, the leaders in their sample differ in their views on how business should operate. Rather than just recognizing the relationships between their business, the natural environment, and society, they 'actively pursue strategies to respect and honor these connections' (p. 34). In other words, sustainability leadership in their model features as a joint vision in which environmental and societal goals are combined with business opportunities.

A final set of studies in the area of sustainability leadership can be found in the area leadership development as well as in the area of (higher) educational programs related to sustainability (e.g., Hargreaves and Fink 2004; Christensen et al. 2007; Burns et al. 2015; Dyer and Dyer 2017). In these approaches, the emphasis is on the development of others in the environment, distribution of responsibilities, and endurance over time (Hargreaves and Fink 2004). Again, in these approaches sustainability features as a visionary component in relation to leadership.

Conclusion

The literature and work under the heading of sustainable or sustainability leadership is growing but so far there is no consensus on what this kind of leadership entails. The question what sustainable or sustainability leadership means, is not so much a semantic discussion rather than the result of different perspectives on sustainability in relation to innovation and leadership. Some use sustainability leadership to better explain the impact of leadership behaviors on sustainability initiatives in organizations and regard it as part of the current developments in the area of ethical leadership. Others see it as research in the area of CSR initiatives. Although leadership is usually associated with leading and managing people in organizations, some work on sustainability leadership does not imply formal management or leadership positions, but rather focuses on it as a proactive behavior anyone could engage in. Leadership means here that people should proactively take charge in order to contribute to global challenges by (collectively) influencing others to act more sustainably. This particular view on sustainable leadership also features in the growing attention to leadership development and education.

The different viewpoints on sustainable leadership stem from different disciplines and so lead to different definitions and applications. Work on leadership in organizations suggests that a combination of inspirational (transformational) and ethical business leadership will be important for creating sustainable innovation. The sense of purpose that an attractive ecological and economically viable vision of the future inspires, acts as a powerful motivating force for those who share the vision. In relation to sustainable innovation, such a vision should relate simultaneously to helping sustain or improve the natural environment and benefit society as well as creating a viable business that will endure and sustain employee well-being. For leaders, this articulated sense of direction is a first step in order to entice followers so that joint efforts may lead to the realization of this vision.

For current or even new business owners, sustainability challenges may act as a source of inspiration for coming up with viable new products, services, or business models that may contribute to society and the natural environment. Sustainability leadership could mean to focus more particularly on what is needed in order to realize ideas in relation to sustainability challenges. Examples of new ventures or transformations of existing businesses that successfully contribute to society and the natural environment may create awareness about sustainability challenges. Such inspirational examples may also lead to a better understanding of the nature of sustainability leadership. Therefore, more examples of such leadership as well as their inclusion in the education of future leaders are needed.

Notes

1. Some proponents of the servant leadership perspective tend to frame servant leadership as positive and transformational leadership as negative. See, for example, Cater and Beal (2015) who claim that 'servant leaders (as opposed to transformational leaders) do not seek power, fame, or self-interests (…) but aim to positively impact the employees and the community above the pursuit of short-term profit' (p. 29). Such statements are problematic for several reasons. First, the theory on transformational leadership does not indicate that such leaders are always seeking power, fame, or self-interests. The theory is about how leaders influence others in order to help attain (group or organizational) goals and the theory is not about the motivations of people to become leaders. Second, transformational leadership also stresses the importance of positive impacts on employees by highlighting the role of individualized consideration (i.e., treating each individual as valuable and unique), intellectual stimulation (i.e., providing subordinates with a flow of challenging new ideas), and some authors even include the use self-sacrifice in order to demonstrate (the leader's) loyalty to the cause. Third, the outcomes of any leadership style are not necessarily positive or negative. Whether reaching a certain goal is positive or negative depends on the perception of the different stakeholders within a specific context and as the work on ethics in leadership shows the effects can differ for different stakeholders. As such, the fact that servant leaders will positively impact the employees and the community is a normative statement since 'leadership is in the eye of the beholder' (Billsberry and Meisel 2009).
2. For more information see the following website: https://www.naturalevolutionfoods.com.au/story/. There is also an interesting piece on Natural Evolution Foods entitled 'Going Bananas,' which was published in the Oct/Nov (2017) issue of the in-flight magazine of Rex Airlines (Australia), 61–64.

References

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Alvesson, Mats. 2000. "Social indentity and the problem of loyalty in knowledge-intensive companies." *Journal of Management Studies* 37 (8): 1101–24.

Amabile, Teresa M., Regina Conti, Heather Coon, Jeffrey Lazenby, and Michael Herron. 1996. "Assessing the work environment for creativity." *Academy of Management Journal* 39 (5): 1154–84.

Anderson, Neil, Kristina Potočnik, and Jing Zhou. 2014. "Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework." *Journal of Management* 40 (5): 1297–333.

Avolio, Bruce J., and William L. Gardner. 2005. "Authentic leadership development: Getting to the root of positive forms of leadership." *The Leadership Quarterly* 16 (3): 315–38.

Bass, Bernard M. 1999. "Two decades of research and development in transformational leadership." *European Journal of Work and Organizational Psychology* 8 (1): 9–32.

Billsberry, Jon, and Steven Meisel. 2009. "Leadership is in the eye of the beholder." *Organization Management Journal* 6 (2): 67–68.

Bocken, Nancy M. P., Samuel W. Short, P. Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, Carlos Montalvo, Jaco Quist, and Marcus Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Brown, Michael E., Linda K. Treviño, and David A. Harrison. 2005. "Ethical leadership: A social learning perspective for construct development and testing." *Organizational Behavior and Human Decision Processes* 97 (2): 117–34.

Burns, Heather, Heather Diamond-Vaught, and Corin Bauman. 2015. "Leadership for sustainability: Theoretical foundations and pedagogical practices that foster change." *International Journal of Leadership Studies* 9: 88–100.

Cater, John, and Brent Beal. 2015. "Servant leadership in multigenerational family firms." *Journal of Applied Management and Entrepreneurship* 20 (4): 25–48.

Christensen, Lisa Jones, Ellen Peirce, Laura P. Hartman, W. Michael Hoffman, and Jamie Carrier. 2007. "Ethics, CSR, and sustainability education in the Financial Times top 50 global business schools: Baseline data and future research directions." *Journal of Business Ethics* 73 (4): 347–68.

De Jong, Jeroen, and Deanne Den Hartog. 2010. "Measuring innovative work behaviour." *Creativity and Innovation Management* 19 (1): 23–36.

Den Hartog, Deanne N. 2015. "Ethical leadership." *Annual Review of Organizational Psychology and Organizational Behavior* 2 (1): 409–34.

Dutton, Jane E., Susan J. Ashford, Regina M. O'Neill, and Katherine A. Lawrence. 2001. "Moves that matter: Issue selling and organizational change." *Academy of Management Journal* 44 (4): 716–36.

Dyer, Georges, and Michelle Dyer. 2017. "Strategic leadership for sustainability by higher education: The American College & University Presidents' Climate Commitment." *Journal of Cleaner Production* 140: 111–16.

Ferdig, Mary A. 2007. "Sustainability leadership: Co-creating a sustainable future." *Journal of Change Management* 7 (1): 25–35.

Fiol, C. Marlene, Drew Harris, and Robert House. 1999. "Charismatic leadership: Strategies for effecting social change." *The Leadership Quarterly* 10 (3): 449–82.

Fry, Louis W. 2003. "Toward a theory of spiritual leadership." *The Leadership Quarterly* 14 (6): 693–727.

Gilson, Lucy L., John E. Mathieu, Christina E. Shalley, and Thomas M. Ruddy. 2005. "Creativity and standardization: Complementary or conflicting drivers of team effectiveness?" *Academy of Management Journal* 48 (3): 521–31.

Gunday, Gurhan, Gunduz Ulusoy, Kemal Kilic, and Lutfihak Alpkan. 2011. "Effects of innovation types on firm performance." *International Journal of Production Economics* 133 (2): 662–76.

Gupta, Vishal, and Shailendra Singh. 2015. "Leadership and creative performance behaviors in R&D laboratories: Examining the mediating role of justice perceptions." *Journal of Leadership & Organizational Studies* 22 (1): 21–36.

Hargreaves, Andy, and Dean Fink. 2004. "The seven principles of sustainable leadership." *Educational Leadership* 61 (7): 8–13.

Horwitz, Frank M., Chan Teng Heng, and Hesan Ahmed Quazi. 2003. "Finders, keepers? Attracting, motivating and retaining knowledge workers." *Human Resource Management Journal* 13 (4): 23–44.

Inigo, Edurne A., and Laura Albareda. 2016. "Understanding sustainable innovation as a complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.

Johnston, Lucas F. 2014. *Religion and sustainability: Social movements and the politics of the environment*. London: Routledge.

Kalshoven, Karianne, Deanne N. Den Hartog, and Annebel H. B. De Hoogh. 2011. "Ethical leadership at work questionnaire (ELW): Development and validation of a multidimensional measure." *The Leadership Quarterly* 22 (1): 51–69.

Kanungo, Rabindra N., and Manuel Mendonca. 1996. *Ethical Dimensions of Leadership*, Vol. 3. Beverly Hills, CA: Sage.

Lüdeke-Freund, Florian, Lorenzo Massa, Nancy Bocken, Alan Brent, and Josephine Musango. 2016. *Business models for shared value*. Cape Town: Network for Business Sustainability South Africa.

Montag, Tamara, Carl P. Maertz Jr., and Markus Baer. 2012. "A critical analysis of the workplace creativity criterion space." *Journal of Management* 38 (4): 1362–86.

Parker, Sharon K., and Catherine G. Collins. 2010. "Taking stock: Integrating and differentiating multiple proactive behaviors." *Journal of Management* 36 (3): 633–62.

Quinn, Laura, and Maxine Dalton. 2009. "Leading for sustainability: Implementing the tasks of leadership." *Corporate Governance: The International Journal of Business in Society* 9 (1): 21–38.

Rosing, Kathrin, Michael Frese, and Andreas Bausch. 2011. "Explaining the heterogeneity of the leadership-innovation relationship: Ambidextrous leadership." *The Leadership Quarterly* 22 (5): 956–74.

Schein, Steve. 2015. *A new psychology for sustainability leadership: The hidden power of ecological worldviews*. Sheffield: Greenleaf.

Shamir, Boas, Robert J. House, and Michael B. Arthur. 1993. "The motivational effects of charismatic leadership: A self-concept based theory." *Organization Science* 4 (4): 577–94.

Tabassi, Amin Akhavan, Kamand M. Roufechaei, Mahyuddin Ramli, Abu Hassan Abu Bakar, Radzi Ismail, and A. Hamid Kadir Pakir. 2016. "Leadership competences of sustainable construction project managers." *Journal of Cleaner Production* 124: 339–49.

Teece, David J. 2010. "Business models, business strategy and innovation." *Long Range Planning* 43 (2–3): 172–94.

Tidd, Joe, John Bessant, and Keith Pavitt. 2005. *Managing innovation integrating technological, market and organizational change*, 5th ed. Chichester: Wiley.

Treviño, Linda Klebe, Michael Brown, and Laura Pincus Hartman. 2003. "A qualitative investigation of perceived executive ethical leadership: Perceptions from inside and outside the executive suite." *Human Relations* 56 (1): 5–37.

Van Dierendonck, Dirk. 2011. "Servant leadership: A review and synthesis." *Journal of Management* 37 (4): 1228–61.

Van Marrewijk, Marcel, and Marco Werre. 2003. "Multiple levels of corporate sustainability." *Journal of Business Ethics* 44 (2–3): 107–19.
Visser, Wayne. 2018. "Creating integrated value: From systems thinking to sustainable transformation in business and society." Inaugural Lecture, No. 3, Antwerp Management School.
Waldman, David A., Donald S. Siegel, and Mansour Javidan. 2006. "Components of CEO transformational leadership and corporate social responsibility." *Journal of Management Studies* 43 (8): 1703–25.
West, Michael A. 2002. "Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups." *Applied Psychology* 51 (3): 355–87.
Wiengarten, Frank, Chris K. Y. Lo, and Jessie Y. K. Lam. 2017. "How does sustainability leadership affect firm performance? The choices associated with appointing a chief officer of corporate social responsibility." *Journal of Business Ethics* 140 (3): 477–93.
Yukl, Gary A. 2012. *Leadership in organizations*, 8th ed. New Delhi: Pearson.

8

Leadership and Goal Setting for Sustainable Innovation Projects in Large Businesses

Ilka Weissbrod

Introduction

Ninety large businesses accounted for almost two-thirds of the global industrial carbon dioxide and methane emissions between 1751 and 2010 (Heede 2014), therefore significantly contributing with these greenhouse gas emissions to climate change. In order for humanity to survive long term on planet Earth, safe planetary operating boundaries have been defined (Rockström et al. 2009). Large businesses are of utmost importance as contributors to the sustainable development that is needed (Ashford et al. 2011; Geels 2011) to ensure that humanity stays within these safe planetary operating boundaries (Rockström et al. 2009).

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This chapter explores the challenges and opportunities of leading sustainable innovation projects in large businesses. These challenges and opportunities are presented from the perspective of corporate project leaders who are responsible for new products and services that shall contribute to sustainable development through creating social, economic and environmental value (i.e. 'triple bottom line' value). Building on interview insights with corporate innovation practitioners in 2013 and 2014, this chapter highlights theory from the domains of sustainable innovation, leadership and organisational management research. Based on the exploration of challenges and opportunities, the chapter contributes to the field of sustainable innovation research through proposing four key decision-making balances that corporate leaders of sustainable innovation projects need to consider.

This chapter consists of three sections. Starting with an overview of why leadership is of utmost importance for sustainable innovation, the chapter goes on to present the methods used to gain practitioner insights. (1) Theory on how goal setting is needed to cut through the complexity of sustainable innovation decision-making and (2) theory on ethical leadership and its link to decision-making during sustainable innovation provide background and context to the practitioner insights prior to the chapter conclusion.

Why is Leadership Especially Important for Sustainable Innovation?

The corporate innovation opportunity space is located at the interface of entrepreneurship and organisational strategy (Drucker 1985; Spender 2014). Sustainable innovation goes beyond conventional innovation (Boons et al. 2013) and has more factors than conventional innovation (Jay and Gerard 2015). Complexity is defined as a high number of interconnected factors (Mitchell 2009). A higher number of factors make sustainable innovation, therefore, more complex than conventional innovation. More trade-offs and challenges exist in sustainable innovation projects than in conventional innovation projects (Adams et al. 2016). Table 8.1 illustrates the difference between conventional and sustainable innovation through showing the higher number of factors that are part of sustainable innovation.

Making decisions in complex situations has long been viewed as very challenging (Van de Ven 1986). In the case of sustainable innovation, adding and managing the needs of environmental and social stakeholders to the mix of decision-making factors increases the number of challenges further. At the same time, the more complex a decision-making situation, the more the decision process—as opposed to the information that feeds into the process—dominates the evaluations that form the basis for decisions (Van de Ven 1986). This is, of course, not ideal because it means that a decision-making process can take priority over the actual sustainable innovation outcome. One argument in the business literature asserts that dealing with the complexities of todays society is led by the individuals at the interface of entrepreneurship and

Table 8.1 Characteristics of conventional versus sustainable innovation

	'Conventional' innovation	Sustainable innovation
Nature of need	• Private • Corporate	• Private • Corporate • Public (environmental and/or social)
Roles	• Private-problem holder • Corporate-problem holder • Knowledge holder • Infrastructure holder	• All of the 'conventional' ones • Public-problem holder
Externality problem	• Single externality (innovation phase)	• Double externality (innovation and diffusion phases)
Challenges	• Access to funding • Innovation culture • Fiscal and regulatory system • Education and training • Coordinated support • Predictability of patterns of final consumer demand	• All of the 'conventional' ones • Directional risk • Success definition and evaluation • User vs. system design duality • Governance (for collaboration across seemingly antagonistic agents)

Adapted from Jay and Gerard 2015

business strategy (Spender 2014). The complex challenges require these individuals to go beyond simple decision-making processes towards a willingness to engage with the more interconnected and complex world around them (Spender 2014). Concurrently, the conventional innovation literature has long asserted that innovation processes outside the status quo of a business or organisation are loaded with uncertainty: of the technological feasibility, market readiness, etc. (Tidd and Bessant 2013). The longer a business engages in any particular innovation project, the higher the resource commitment is for the business, in terms of time and money spent. It is key for businesses to avoid over-commitment of these resources to any innovation project where the uncertainties have not been sufficiently tested (Blank 2011). Equally, shutting down an innovation project too soon will result in the loss of potentially successful business propositions (Tidd and Bessant 2013). Figure 8.1 illustrates how, ideally, decision-making by innovation project leaders will lead to

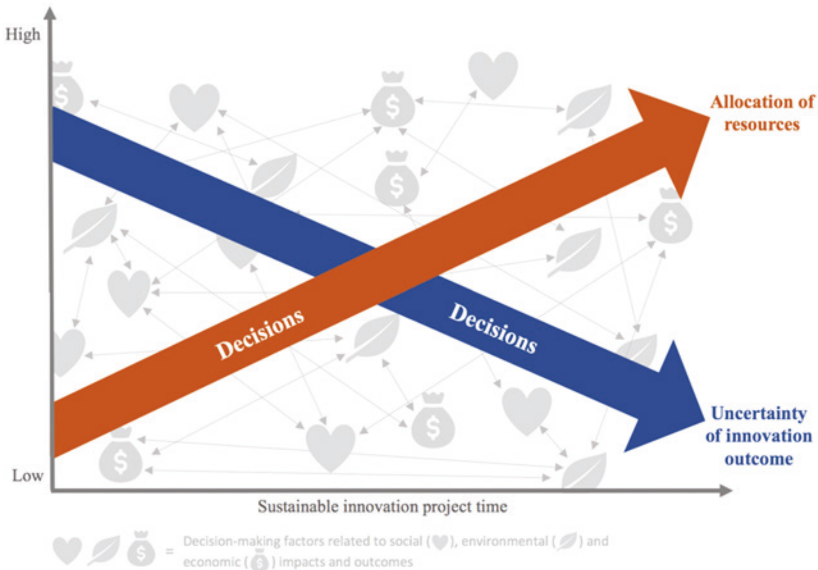

Fig. 8.1 Ideal decision outcome of the relationship between sustainable innovation project uncertainty and corporate resources (building on Tidd and Bessant 2013)

a reduction of uncertainty during the course of a sustainable innovation project, whilst the allocation of resources to this project gradually increases. The decision-making of corporate sustainable innovation leaders, throughout the whole timeline of the project, needs to consider a high number of interconnected triple bottom line value creation factors.

For conventional innovation, businesses need to have an internal review structure that evaluates information about technical feasibility and market readiness to help reduce uncertainty and enable decision-making on releasing corporate resources (Tidd and Bessant 2013). The ongoing information review enables measuring the progress of the innovation project (Tidd and Bessant 2013). With sustainable innovation, there are further dimensions to consider whilst testing the feasibility of innovation propositions that serve economic, social and environmental value creation. An example of such a dimension is societal change that is the result of more sustainable novel products, services or business models (Adams et al. 2016). Before commencing sustainable innovation projects, corporates should identify the environmental and social issues that are the most relevant to stakeholders, i.e. material to the stakeholders (Eccles and Serafeim 2013). This shall enable focusing innovation efforts on the most material parts of concerns whilst promising economic value creation (Eccles and Serafeim 2013). Unfortunately, however, for sustainable innovation project leaders in the business world, once sustainable innovation project has commenced, there are currently no widely adopted tools or methods that might be used to consider social, environmental and economic value creation during product innovation processes (Zetterlund et al. 2016). A recent review of tools in the field of sustainable innovation has found that tools such as materiality analysis (Eccles and Serafeim 2013) are not widely used once sustainable innovation projects have started. The researchers state that '*the methodological support for considering sustainability aspects in product development is still immature and poorly implemented*' (Zetterlund et al. 2016: 291). In particular, the social dimension of sustainable value creation was not considered as much as environmental and economic measures (Zetterlund et al. 2016). As for environmental sustainability, an empirical analysis of sustainability management tools (accounting tools, indicators, product design and communication) found that implementing such tools does successfully reduce environmental impacts per unit of revenue (Hörisch et al. 2015). For absolute reductions, needed to stay within save planetary operating boundaries (Rockström et al. 2009) and how to thrive for such absolute reductions in business emissions through product design and innovation tools (Hörisch et al. 2015) is yet to be determined. It follows that sustainable innovation project leaders, usually, have to adapt new tools and approaches to aid their decision-making during sustainable product and service development.

Methodology

I conducted exploratory research on the characteristics of radical sustainability-oriented innovation in 2013–2014 through semi-structured interviews. I asked the interviewee views on

1. what the interviewee considers to be radical innovation,
2. what the interviewee considers to be radical sustainable innovation, and
3. who the interviewee thinks succeeded in either of those.

This chapter draws on the responses of 9 practitioners who all were current or past project leads, with explicit sustainable innovation responsibility. In addition, data from 2 interviewees working, respectively, in a sustainable innovation consultancy and on a substantial sustainable innovation intrapreneurship project were included. The interviews were conducted in the USA and the EU: either during innovation conferences, in pre-arranged meetings or, on one occasion, over the phone. Interviews lasted between 5 and 64 minutes each, were voice-recorded, verbatim transcribed, uniformly formatted in a natural transcript structure (McLellan et al. 2003) and analysed in the qualitative software analysis software ATLAS.ti, using Descriptive coding and In Vivo coding[1] (Miles et al. 2014). The challenges and opportunities of leading sustainable innovation projects presented in this chapter are based on the themes that emerged from coding the interviews. A selection of quotes highlights where there are differences and overlap between theory and practice. The interviews started as a way of '*tapping people for information*' (Alvesson and Ashcraft 2009: 69) on radical sustainable innovation. In addition to this initially desired information, the interviews resulted in insights on the challenges of furthering sustainable innovation projects through leadership and goal setting. This surprising outcome aligns with the notion that interviews are '*seen as expressing not so much actual events as the experiences and meanings of participants*' (ibid.: 70).

Two Dimensions of Sustainable Innovation Project Decision-Making: 'Rational Action' and 'Rule Following'

This chapter argues that sustainable innovation projects are more complex than conventional innovation projects because they contain more factors than conventional innovation (see Jay and Gerard 2015). In addition, conventional innovation is differentiated from sustainable innovation through the problem to be solved through innovation activities (Dyllick and Muff 2016) and the aspirations of business to operationalise sustainable development (Adams et al. 2016). Sustainable innovation project outputs should benefit others (e.g. social and environmental outputs) than purely the business pursuing the innovation (Adams et al. 2016; Bocken et al. 2015; Charter et al. 2008; Elkington 1994). Setting innovation output goals is needed to enable a team to achieve sustainable innovation as opposed to solely conventional innovation—already a challenging process as shown in Table 8.1. To add to these challenges, the goals of any innovation activity might change with new learning derived during the innovation process (Velu and Stiles 2013). There are two main perspectives on decision-making that leaders may apply to navigate the ever-changing landscape of their innovation project.

Firstly, the 'rational action' point of view. This perspective on interpreting a situation asserts that meaning in a situation is established in order to make decisions: '*decisions are important because they allocate resources and produce measurable consequences for the decision maker. Information is meaningful if it resolves uncertainties about preferences,* *consequences, situations, and identities. What are the implications for profits, costs, and sales in a business firm?*' (March and Heath 1994: 207). Applying this to Fig. 8.1, sustainable innovation leaders would pick out a selection of the interconnected triple bottom line value creation factors, gather information and narrow down the uncertainty accordingly. This 'rational action' approach is, however, rarely used in practice in sustainable innovation projects with a high degree of uncertainty—or even in conventional innovation projects exploring value propositions outside the current product and service status quo (Van de Ven 1986). 'Rational action' decision-making (March and Heath 1994) and/or a logical innovation decision structure (Bessant and Tidd 2015) are easily propositioned in theory, harder to implement in practice during innovation projects that go beyond improving the existing product and service status quo. This innovation practitioner clearly articulates this gap between 'rational action' decision-making theory and practice. He led a sustainable innovation project that set out to bring about societal change at the systems level (Adams et al. 2016) in a developing market.

> Look, many companies don't have very structured formal processes, where something matures from an idea to a concept note to a business plan to a venture, like that very logical go/no go decision point structure. That's the way it ought to be done, but it's not the way it's done in most companies. There may be a division that does that, but when you have outlier concepts—they don't fit into that structure.
> **Product Innovation Leader | Biotechnology Firm | 2014**

The second perspective on decision-making views the construction of meaning in the decision-making process differently. Here, decision-makers interpret a situation in order to establish how the situation fits with personal and organisational rules, with accumulated intelligence amending these rules over time. In this 'rule following' approach, '*interpretation is treated as central, sense making as a basic need. Humans spend much of their time gossiping about the motives and the behaviour of others. In this view, meaning is not established to make decisions; decisions are made to establish meaning*' (March and Heath 1994: 208). This 'rule following' perspective is closely aligned to the argument of innovation research that asserts that new value creation requires emotional engagement of sustainable innovation teams (e.g. Lampikoski et al. 2014).

The biotechnology firm innovation leader above uses the term ‘outlier concept’ to describe innovation outside the existing product and service development status quo within a business. Theory has, indeed, acknowledged that a rational decision-making structure is unlikely under such circumstances (Barrett 1998; Van de Ven 1986) because of what advocates of ‘rule following’ critique as the ‘excessive informational and cognitive requirements’ (March and Heath 1994: 221)[2] needed during the implementation of a ‘rational action’ decision-making process.

Emotional Engagement in Sustainable Innovation Projects

Sustainable innovation with its many factors and extremely high level of uncertainty is innovation that requires ‘do different’: it is associated with lack of information and, therefore, a higher level of risk (Tidd and Bessant 2013). In this case, an innovation leader might need to engage others through a powerful narrative argument, thrill them and engage them with passion for a project, or elicit emotions such as reward of a successful innovation or fear of not conducting this project (Tidd and Bessant 2013). In essence, innovation managers looking to create new business models and means of value creation need to move their respective business and innovation teams away from the rationale of evolutionary/incremental innovation (Lampikoski et al. 2014). Such incremental innovation involves ‘*gradual changes to the existing activities and business model elements to adapt to sustainability-related changes*’ (Inigo et al. 2017: 5). Others have argued that large businesses are well placed to conduct such innovation because they have refined sustainability management systems and an established market presence (Hockerts and Wüstenhagen 2010). In contrast, radical innovation outside the current business status quo ‘*implies introducing a completely new form of structuring the value creation*’ (Inigo et al. 2017: 5) of a business. This radical sustainable innovation is usually connected with smaller businesses. Large businesses, however, are spurred on by the efforts of small market disrupters to pursue sustainable innovation outside of the current organisational status quo (Hockerts and Wüstenhagen 2010). It has been proposed that sustainable innovation outside the current business status quo can be achieved through creating a 'playground' for experimentation (Lampikoski et al. 2014). Research suggests that such exploratory spaces (both physical and metaphorical) can help to stimulate the passion needed to encourage others to engage in innovation activities with high levels of risk (Lampikoski et al. 2014). This playground for experimentation can be explored by different means, be it sandpits, tiger teams and blue-sky teams. It is important to set constraints for these exploratory innovation activities, in order to enable innovation teams to break out of a process-oriented mind frame, likely to take over in complex decision-making situations (Van de Ven 1986). Removing routine elements from the innovation process is one way of doing this and encourages team members to develop new solutions to a stated innovation problem (Barrett 1998). It is important to focus on furthering the goals of the sustainable innovation project and to avoid exploratory activities that do not reduce the uncertainties associated with the project: it is a fine balance between engaging a team in an innovation project through passion (Bessant and Tidd 2015) and keeping the team focused on a specific innovation goal, usually a problem to be solved (Blank 2011; Charter et al. 2008). When using exploratory innovation methods, innovation project leaders should ensure that the focus is kept (Barrett 1998). Because getting caught up in the process of creativity can happen, this innovation leader highlights:

> Certainly worth thinking about is, how do you foster that [*creative innovation*] culture effectively in that you have runaway creativity without runaway tangents.
> **Blue Sky R&D Programme Leader | Multinational Technology Company | 2014**

This innovation leader went on to explain that in his team, stating the goal (of 'providing affordable eye care in bottom of the pyramid countries') repeatedly during creative sessions and ensuring that the innovation goal is pinned to the top of the digital team communication channel are two mechanisms used to avoid runaway tangents. He conceded though, that even with these mechanisms, he has to intervene repeatedly through personal communication with some individuals within his team for whom this is harder to achieve than for other team members.

Adjusting Decisions to Changing Goalposts in Sustainable Innovation Projects

Focus on innovation goals is important—but innovation goals move due to new information gained during the innovation process (Velu and Stiles 2013). So how might sustainable innovation project leaders make decisions that further economic, social and environmental value creation? How might they decide on the adjusting of the former stated goal of innovation activities? Like in so many other corporate contexts, communication is highlighted as the key mechanism for leaders to focus on, both by the practitioners interviewed for this chapter and in academic theory. For example, interpreting a complex situation and communicating well within a team is asserted to be essential to help achieve and adjust goals (Guarana and Hernandez 2015; Metcalf and Benn 2013). Leaders who encourage collaborative learning and positive team member relations (Guarana and Hernandez 2015) are likely to succeed in creating the exchange of ideas and decision-making processes with their 'followers' that are needed for interpretation and decision-making in complex situations. Making decisions in complex situations is '*near the edge of chaos*' (p. 51) and benefit from leaders and followers influencing each other through setting collective goals (Guarana and Hernandez 2015). At the same time, sustainable innovation requires new corporate innovation and corporate management processes. It has been argued that there is a need to have freedom at the individual level in order to explore new organisational processes (Nooteboom 2000; March 1991). The setting of collective goals to achieve sustainable innovation, in combination with freedom at the individual level, to create new organisational innovation processes can work in practice. One interviewee found, indeed, that one can only work if the other is granted. He found that only in allowing team members to discover personal sustainability meaning in a team innovation goal, they collectively were able to change their corporate innovation process.

> I do work in a corporate structure and I know where I want to go, but getting there is the hardest thing. I used to think that colleagues had to find the same sustainability meaning in the innovation opportunity that I did, and what I'm finding is that that's not necessarily the case. People could find 10 different things in the same thing to get to the same result. I'm constantly working within a system that resists change, so even for some people what might be a simple thing is sometimes quite hard and clear goals help to overcome this challenge.
> **Industrial Design Leader | Luxury Interiors Manufacturer | 2013**

The design team leader in the manufacturing business found that if he granted freedom at the individual level, he and his team were able to articulate a sustainable innovation goal that allowed overcoming corporate structural barriers to change. Other research has asserted that borrowing from startup culture, where teams focus on an innovation idea from inception to market introduction, may help to overcome the structural barriers (Sandberg and Aarikka-Stenroos 2014) innovation outside the corporate status quo encounters. It has been found that sustainable innovation may use lean startup processes to further social, economic and environmental value creation goals (Weissbrod and Bocken 2017), with learning determining which aspects of this triple bottom line value creation (Elkington 1994) need to be explored further. Fast learning cycles are the key method used during this sustainable innovation process.[3] An innovation practitioner working for a large health care technology company used the term 'tiger team' to allude to the fact that most successful startups completely focus on developing one new product or service project, and how this approach has been proven to work within the boundaries of a large corporation too.

> These start-ups inside the company, they form tiger teams of different functions and the tiger team stays with the construct to finish. We've seen the biggest success coming from that same kind of model, we have a CEO—whatever you call it, CEO, GM, Project Manager, Program Manager, whatever, who takes it from start all the way to finish to the point where they're in market. So they've not only been involved with R&D but now they're in market, they're learning and they're taking it all the way to follow-through (*author note: all the way to commercialisation*).
> **High Impact Innovation Leader | Healthcare Technology Company | 2013**

This approach was only taken within the 'high impact' innovation team, where innovating to achieve social change in addition to change in the marketplace (see Adams et al. 2016) was a key objective for the team according to the interviewee.

Entrepreneurial Leadership to Tackle Uncertainty

There are multiple levels of complexity involved in the process of embedding sustainability into large businesses of understanding sustainability challenges, of complex problem-solving and of leadership (Metcalf and Benn 2013). In order to address these three layers of complexity, leaders of extraordinary ability are required (Metcalf and Benn 2013). However, the individuals pursuing business innovation in the face of uncertainty are by no means always successful, and there is no recipe to guaranteed success. This has long been acknowledged by scholars: '*Where the boundaries of routine stop, many people can go no further, and the rest can only do so in a highly variable manner*' (Schumpeter 1934: 80). The perseverance required by individuals that pursue innovations outside the existing business status quo has been associated with strong physical, even fighting qualities. There is 'entrepreneurial judo' (Drucker 1985), 'business athletes' skills (Moss Kanter 1989) and the 'Maverick' (Ford and Probert 2011). Past business performance data are not suitable to determine a suitable path of action forward—business leaders have to be comfortable with uncertainty and adopt 'entrepreneurial leadership' (Greenberg et al. 2013). At the heart of such leadership is taking action in the face of uncertainty instead of focusing on process (Van de Ven 1986), and each action provides more insight into a problem (Greenberg et al. 2013). Both the main perspectives on decision-making as summarised by March and Heath (1994) need, therefore, to come into play during innovation project leadership within corporates. Additionally, effective communication is needed to enable innovation project leaders to tackle the high level of complexity (Guarana and Hernandez 2015) associated with sustainable innovation.

Ethical Leadership and Sustainable Innovation Projects

Large businesses engage in sustainable innovation projects because they identified a business case for sustainability (Boons and Wagner 2009, Schaltegger and Burritt 2018). The ethical motivations of corporate leaders have been shown to be an important factor in determining (1) what type of business case a corporation engages in, (2) how stretching social and environmental goals and activities are, and (3) how economically successful the corporation is due to the operationalisation of the business case (Schaltegger and Burritt 2018). Collaboration with stakeholders to develop the corporate business case for sustainability has been argued to lead to higher economic success and more stretching social and environmental activities than business cases that are based on reactionary (e.g. philanthropic measures) and reputational (e.g. communication measures) ethical motivations of corporate decision-makers (Schaltegger and Burritt 2018). Collaborative dialogue with stakeholders including vulnerable stakeholders is the sole business case linked to 'do different' innovation (Tidd and Bessant 2013) that can lead to business model innovation. The collaborative dialogue that is the basis for the most stretching business case for sustainability in Schaltegger and Burritt (2018) relies on two-way communication with stakeholders. Other researchers have identified the desire to engage in two-way communication as key behaviour characteristic that is a common trait of ethical leaders (Brown and Treviño 2006; Den Hartog 2015; Guarana and Hernandez 2015). The four additional characteristics are identified as concern for ethics, morality, other people and power sharing (Den Hartog 2015). Communication was also a component of this ethical leadership definition: '*the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships, and the promotion of such conduct to followers through two-way communication, reinforcement, and decision-making*' (Brown et al. 2005: 120). The corporate reality of changing team members is possible to accommodate in this two-way communication and power sharing, as this blue-sky thinking innovation leader shares from his experience with leading an experimental product innovation project in a technology company:

> For a team to be successful as it grows, I think it needs leadership. On the other hand, and then the flip side of that is, once you have leadership you have to respond to that leadership, one way or the other. So group dynamics come in and that's the same with any group. (…) We spend a lot of time, experimenting with *(product specifications).* They've been working with it for a while. Somebody who came onto the team later, about halfway through the last year, had a huge impact on how things ended up going because he just happened to have the experience set and had an idea that worked really well. And so, it's a culture of everybody has the opportunity to contribute. And when you can contribute, if you take advantage of that opportunity, then good things come about.
> **Blue Sky R&D Programme Leader | Multinational Technology Company | 2014**

Researchers have proposed (Brown et al. 2005) and subsequently concluded the validity (Mayer et al. 2012) of a social learning perspective on ethical leadership. In this perspective, leaders guide the ethical conduct of team members through their behaviour, in effect enabling team members to follow their conduct as models (Brown et al. 2005; Mayer et al. 2012). It is, therefore, important for sustainable innovation project leaders to practice the common traits of ethical leaders. Because, even in the 'conventional' management literature, Spender (2014) argues that '*managers cannot ever escape moral and ethical responsibility for the choices they make in uncertain situations that are the defining characteristic of capitalist democracy*' (p. 255).

As for deeper links between sustainable innovation and ethical leadership, a recent review of the ethical leadership field argues that what makes this leadership unique and the '*role of intentions, and the role of the context*' (Den Hartog 2015: 429) is still to be determined. At present, social and environmental dimensions are not widely included in what makes for ethical leadership (Den Hartog 2015); however, ethical motivations have been set in the context in corporate engagement with sustainability by others (Schaltegger and Burritt 2018). Previously, a group of researchers included 'environment orientation' as trait of ethical leadership behaviour (Kalshoven et al. 2011). The researchers attempting this outlined that '*paying attention to sustainability issues, considering the impact of their actions beyond the scope of their own work-group, and demonstrating care about the welfare of the society*' (Kalshoven et al. 2011: 53). Caring about the welfare of society is closely related to the net positive impact on society that the sustainable innovation theory states as business innovation outcome at the systems level (Adams et al. 2016).

Future research will benefit from evaluating how the common traits of ethical leadership relate to and impact the different business cases with regard to sustainability proposed by Schaltegger and Burritt (2018). This will enable sustainable innovation project leaders in corporates to further develop these common traits whilst thriving to tackle the uncertainty of ambitious sustainable innovation projects.

Conclusions

This chapter set out to explore the key challenges and opportunities for leadership and goal setting for sustainable innovation projects in large businesses. The deceptively easy task of gathering information to reduce uncertainty during innovation processes and to wisely allocate resources (Fig. 8.1) is very challenging for the leaders of sustainable innovation projects. The challenges presented were enriched by insights from cross-sectoral business practitioner interviews. The chapter linked the theory on ethical leadership with the sustainable innovation project challenges. This link helped to refine how sustainable innovation project leaders in large businesses might overcome the challenges they are likely to encounter whilst making decisions on the allocation of resources and the reduction of uncertainty. Two-way communication was argued to be especially important. As well as practicing and encouraging two-way communication, this chapter teased out four key balances that need to be considered by the leaders of sustainable innovation projects in large businesses:

A logical innovation decision structure	versus	The lack of information associated with pursuing sustainable innovations that are new to the business
A clear sustainability goal for innovation activities	versus	The freedom for team members to find personal meaning in the sustainability goal
Thriving to pursue sequential learning to reduce uncertainty	versus	Taking action in the face of uncertainty
Serving the corporate sustainability strategy	versus	Pursuing an entrepreneurial approach within business boundaries

Notes

1. March and Heath (1994) allude to the criticisms of both 'rational action' and 'rule following'; the authors do not proclaim preference of one decision-making approach over the other.
2. Chapter 18 'Experimentation for Sustainable Innovation' provides details on this method.
3. Descriptive coding assigns '*labels to data to summarise in a word or short phrase—most often a noun—the basic topic of a passage of qualitative text*' (Miles et al. 2014: 74); In Vivo coding uses a word or phrase the interviewee used to describe a text section (ibid.).

References

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Alvesson, Mats, and Karen Lee Ashcraft. 2009. "Critical methodology in management and organization research." In *The SAGE handbook of organizational research methods*, 61–77. London, UK: Sage.

Ashford, Nicholas A., Ralph P. Hall, and Kate Parrot. 2011. "Organizational innovation and learning: The role of the industrial firm in achieving sustainable development." In *Technology, globalization, and sustainable development—Transforming the industrial state*, 287–335. Yale University Press.

Barrett, Frank J. 1998. "Coda—Creativity and improvisation in jazz and organizations: Implications for organizational learning." *Organization Science* 9 (5): 605–622.

Bessant, John, and Joe Tidd. 2015. *Innovation and entrepreneurship*, 3rd ed. Chichester, UK: Wiley.

Blank, Steve. 2011. "Embrace failure to start up success." *Nature News* 477 (7363): 133.

Bocken, N. M. P., P. Rana, and S. W. Short. 2015. "Value mapping for sustainable business thinking." *Journal of Industrial and Production Engineering* 32 (1): 67–81.

Boons, Frank, Carlos Montalvo, Jaco Quist, and Marcus Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Boons, Frank, and Marcus Wagner. 2009. "Assessing the relationship between economic and ecological performance: Distinguishing system levels and the role of innovation." *Ecological Economics* 68 (7): 1908–14.

Brown, Michael E., and Linda K. Treviño. 2006. "Ethical leadership: A review and future directions." *The Leadership Quarterly* 17 (6): 595–616.

Brown, Michael E., Linda K. Treviño, and David A. Harrison. 2005. "Ethical leadership: A social learning perspective for construct development and testing." *Organizational Behavior and Human Decision Processes* 97 (2): 117–34.

Charter, Martin, Casper Gray, Tom Clark, and Tim Woolman. 2008. "Review: The role of business in realising sustainable consumption and production." In *System Innovation for Sustainability*, ed. Arnold Tukker, Martin Charter, Carlo Vezzoli, Eivind Sto, and Maj Munch Andersen, 46–69. Sheffield, UK: Greenleaf Publishing.

Den Hartog, Deanne N. 2015. "Ethical leadership." *Annual Review of Organizational Psychology and Organizational Behavior* 2 (1): 409–34.

Drucker, P. F. 1985. "The practice of innovation." In *Innovation and entrepreneurship practice and principles*, 19–33. New York: Harper & Row.

Dyllick, Thomas, and Katrin Muff. 2016. "Clarifying the meaning of sustainable business: Introducing a typology from business-as-usual to true business sustainability." *Organization & Environment* 29 (2): 156–74.

Eccles, Robert G., and George Serafeim. 2013. "The performance frontier." *Harvard Business Review* 91 (5): 50–60.

Elkington, John. 1994. "Towards the sustainable corporation: Win-win-win business strategies for sustainable development." *California Management Review* 36 (2): 90–100.

Ford, Simon, and David Probert. 2011. *Organising for breakthrough innovation: Rejuvenating the established firm*. Cambridge, UK: University of Cambridge, Institute for Manufacturing.

Geels, Frank W. 2011. "The multi-level perspective on sustainability transitions: Responses to seven criticisms." *Environmental innovation and societal transitions* 1 (1): 24–40.

Greenberg, Danna, Kate McKone-Sweet, and H. James Wilson. 2013. "Entrepreneurial leaders: Creating opportunity in an unknowable world." *Leader to Leader* 2013 (67): 56–62.

Guarana, Cristiano L., and Morela Hernandez. 2015. "Building sense out of situational complexity: The role of ambivalence in creating functional leadership processes." *Organizational Psychology Review* 5 (1): 50–73.

Heede, Richard. 2014. "Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010." *Climatic Change* 122 (1–2): 229–41.

Hockerts, Kai, and Rolf Wüstenhagen. 2010. "Greening Goliaths versus emerging Davids—Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship." *Journal of Business Venturing* 25 (5): 481–92.

Hörisch, Jacob, Eduardo Ortas, Stefan Schaltegger, and Igor Álvarez. 2015. "Environmental effects of sustainability management tools: An empirical analysis of large companies." *Ecological Economics* 120: 241–49.

Inigo, Edurne A., Laura Albareda, and Paavo Ritala. 2017. "Business model innovation for sustainability: Exploring evolutionary and radical approaches through dynamic capabilities." *Industry and Innovation* 24 (5): 515–42.

Jay, Jason, and Marine Gerard. 2015. "Accelerating the theory and practice of sustainability-oriented innovation." MIT Sloan Research Paper No. 5148–15. Available at SSRN: https://doi.org/10.2139/ssrn.2629683.

Kalshoven, Karianne, Deanne N. Den Hartog, and Annebel H. B. De Hoogh. 2011. "Ethical leadership at work questionnaire (ELW): Development and validation of a multidimensional measure." *The Leadership Quarterly* 22 (1): 51–69.

Lampikoski, Tommi, Mika Westerlund, Risto Rajala, and Kristian Möller. 2014. "Green innovation games: Value-creation strategies for corporate sustainability." *California Management Review* 57 (1): 88–116.

March, James. 1991. "Exploration and exploitation in organizational learning." *Organization Science* 2 (1): 71–87.

March, James, with the assistance of Chip Heath. 1994. *A primer on decision making: How decisions happen*. New York, USA: The Free Press.

Mayer, David M., Karl Aquino, Rebecca L. Greenbaum, and Maribeth Kuenzi. 2012. "Who displays ethical leadership, and why does it matter? An examination of antecedents and consequences of ethical leadership." *Academy of Management Journal* 55 (1): 151–71.

McLellan, Eleanor, Kathleen M. MacQueen, and Judith L. Neidig. (2003) "Beyond the qualitative interview: Data preparation and transcription." *Field Methods* 15 (1): 63–84.

Metcalf, Louise, and Sue Benn. 2013. "Leadership for sustainability: An evolution of leadership ability." *Journal of Business Ethics* 112 (3): 369–84.

Miles, Matthew B., A. Michael Huberman, and Johnny Saldana. 2014. *Qualitative data analysis: A methods sourcebook*, 3rd ed. Thousand Oaks, USA: Sage Publications.

Mitchell, Sandra D. 2009. *Unsimple truths: Science, complexity, and policy*. Chicago, USA: University of Chicago Press.

Moss Kanter, Rosabeth. 1989. *When giants learn to dance.* New York, USA: Simon & Schuster.

Nooteboom, Bart. 2000. *Learning and innovation in organizations and economics*. Oxford, UK: Oxford University Press.

Rockström, Johan, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin III, Eric Lambin, Timothy M. Lenton, et al. 2009. "Planetary boundaries: Exploring the safe operating space for humanity." *Ecology and Society* 14 (2): 32.

Sandberg, Birgitta, and Leena Aarikka-Stenroos. 2014. "What makes it so difficult? A systematic review on barriers to radical innovation." *Industrial Marketing Management* 43 (8): 1293–305.

Schaltegger, Stefan, and Roger Burritt. 2018. "Business cases and corporate engagement with sustainability: Differentiating ethical motivations." *Journal of Business Ethics* 147 (2): 241–59.

Schumpeter, Joseph A. 1934. *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, USA: Harvard University Press.

Spender, J.-C. 2014. *Business strategy: Managing uncertainty, opportunity, and enterprise*. Oxford, UK: Oxford University Press.

Tidd, Joe, and John Bessant. 2013. *Managing innovation: Integrating technological, market and organizational change*, 5th ed. Chichester, UK: Wiley.

Van de Ven, Andrew H. 1986. "Central problems in the management of innovation." *Management Science* 32 (5): 590–607.

Velu, C., and Stiles, P., 2013. Managing decision-making and cannibalization for parallel business models. *Long Range Planning* 46 (6): 443–58.

Weissbrod, Ilka, and Nancy M. P. Bocken. 2017. "Developing sustainable business experimentation capability—A case study." *Journal of Cleaner Production* 142: 2663–76.

Zetterlund, Helena, Sophie Hallstedt, and Göran Broman. 2016. "Implementation potential of sustainability-oriented decision support in product development." *Procedia CIRP* 50: 287–92.

9

Exploring the Pitfalls of Systemic Innovations for Sustainability

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Introduction

Innovation plays an important role in the sustainability journey (Lin and Tseng 2016; Silvestre 2015). Recent management literature (e.g., Boons et al. 2013) advocates for firms to shift from a focus on a linear supply chain toward systems building and engaging with external stakeholders (Adams et al. 2016; Inigo and Albareda 2016; Medeiros et al. 2014) to improve the entire system through accelerated and transformative change (e.g., Nidumolu et al. 2009; Quist and Tukker 2013). Taking the lead in shaping the market/industry transformation may

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grant major strategic advantages enabled by radical innovations aiming at systems changes (Boons et al. 2013; Hansen et al. 2009; Seebode et al. 2012).

While the ambition beyond incremental change exists, the evidence suggests that firms fail largely in delivering game-changing innovations for sustainability (Accenture 2015) and produce instead only incremental innovations inadequate for solving the sustainability challenges (Van den Bosch et al. 2015). There is a fundamental gap in moving from ambition to execution. In this study, we heed the recent call from Xavier et al. (2017) to explore the implementation of innovation for sustainability by asking: *What are the main challenges in delivering systemic innovations for sustainability?*

We have built a literature-based framework and added an empirical perspective to the debate about inaction by exploring the perceptions of business leaders in a multi-industry sample of globally operating Finnish companies. The data comprised 27 interviews in 13 companies. We found the respondents to converge on common challenges, regardless of the industry or the specific context, which could be explained by current dynamic capabilities not being able to address the idiosyncratic demands of developing systemic innovations for sustainability.

Our empirical results support the existing literature about the challenges of systemic innovations for sustainability (Boström et al. 2015; Mignon and Bergek 2016; Roscoe et al. 2016; Silvestre 2015), and according to the results, firms face three categories of inter-connected challenges: structural impediments, uncertainty avoidance and conflicting aims within and between firms. Each challenge is connected to lacking capabilities in open innovation, evaluating and seizing radical opportunities, and reconfiguring the organization for systemic innovations for sustainability.

Systemic Innovations for Sustainability

Sustainability is a journey toward engaging environmental, social and economic goals to deliver societal benefits from business activity (Elkington 1997). Sustainability represents the balancing of internal goals with external dynamics (Lozano 2015) to optimize collective value in the long term. Firms are driven to broadening their engagement and acting to improve the system as a whole (Gaziulusoy and Brezet 2015; Adams et al. 2016). However, this approach has not been realized yet (Accenture 2015).

Innovation could fill this gap through delivering new technologies, tools and processes, and ultimately a new mind-set (Adams et al. 2016; Medeiros et al. 2014). *Innovations for sustainability* are understood as commercialized inventions (e.g., products, technologies, services, processes and business models) that aim at creating economic, environmental and social value (e.g., Seebode et al. 2012; Schiederig et al. 2012; Schaltegger and Wagner 2011). Taking them to the systemic level, i.e., *systemic innovations for sustainability*, can also include wider society-level changes, e.g., market and user practices, policies, regulations, culture, technologies or firm management practices (Gaziulusoy and Brezet 2015).

Such innovations consider the impacts across the entire supply chain and can tackle sustainability-related challenges (Boons et al. 2013; Lin and Tseng 2016), create sustainable business value (Bocken et al. 2014) and deliver an overall positive impact on the system (Hansen et al. 2009). Innovating on the systemic level provides improved options for game-changing or 'radical' innovation (Quist and Tukker 2013) that may reposition firms to lead the market/industry transformation and impose change on the competition (Schaltegger and Wagner 2011). Systemic innovations for sustainability introduce complex or even paradoxical system effects that go beyond simple cause-and-effect management toward systems building (Adams et al. 2016) and require specific capabilities to deliver them.

Systemic innovation increases a firm's interdependence with its stakeholders and environment (Eccles et al. 2014). By managing their dependence on complex external systems and supply chains, firms may create networks that provide resilience. However, this requires the building of collaborative (open innovation) skills with greater network management capabilities (Van den Bosch et al. 2015). This collaboration shapes the evolution of supply chains (Silvestre 2015) and provides seeds for sustainable transitions (Markad et al. 2012). Hence, systemic innovation requires adopting a new set of skills, capabilities and approaches (Medeiros et al. 2014; Seebode et al. 2012) geared toward collaboration and supply network management (Roscoe et al. 2016).

Adaptation to changing business environments is accomplished through the application of dynamic capabilities (Teece et al. 1997). They allow reconfiguration of the firm's resources and knowledge capacities to achieve higher technical and/or evolutionary fitness in their business environment (Teece 2007; Helfat and Peteraf 2003) and facilitate business model experimentation (Teece 2017). Dynamic capabilities are context-dependent (Eisenhardt and Martin 2000), which means that what enables success in one environment may obstruct performance in another.

Success built on high technical and evolutionary fitness, i.e., strong economic innovation performance and fit with the core market, can hold back transitioning to systemic innovation. Systemic innovations change the boundaries of the firm, eroding thus evolutionary fitness and reducing the effectiveness of existing dynamic capabilities. Knowledge and capability path dependencies introduce inertia to change processes (Eisenhardt and Martin 2000), which increases the financial and performance costs associated with capability reconfiguration. To maximize long-term sustainable value, non-efficiency perspectives need to accompany decision-making with, e.g., alliance, innovation or stakeholder engagement issues.

Similar challenges have been identified in transitioning to open innovation (Lichtenthaler and Lichtenthaler 2009), where sustainable systemic innovation introduces further challenges of deeper stakeholder dependence and coordination. Additionally, systemic innovations call for acquiring and exploiting synergies between open and radical innovation capabilities (Slater et al. 2013). To accomplish this, the dynamic capabilities need to be updated to accommodate a broader range of stakeholders, to allow effective use of 'distant' and external knowledge and to address the requirements of open innovation (Behnam et al. 2018; Teece 2007; Lichtenthaler and Lichtenthaler 2009).

Acquiring, strengthening and exploiting capabilities successfully in the pursuit of systemic sustainable innovation are a multi-level management challenge (Lichtenthaler 2011). Interdependent changes need to be introduced on the levels of organizational structure, culture, leadership and strategy, as well as individual skills and project-level decision-making. Dynamic capabilities are often built from benchmarking relevant practices and routines in the familiar market environment and the competition (Teece et al. 1997; Teece 2007) through experimentation and experience. However, as the systemic transition is only at its beginning, organizations have few best practices to draw from, while complexity prevents relying exclusively on 'ad hoc problem solving' (Winter 2003).

Methods and Research Design

Our research is a qualitative, explorative multiple case study in a multi-industry context in Finland. An inductive case study approach was selected due to its suitability for examining a topic with scarce empirical research (Eisenhardt and Graebner 2007; Yin 2014). We have applied theoretical sampling (Eisenhardt and Graebner 2007) to identify cases of firms with serious commitment to sustainability. The data comprises 27 in-depth, recorded and transcribed semi-structured interviews of 40 informants from 13 established, internationally operating companies from Finland. The participants were experienced senior managers working at environmental, innovation and business management, with titles ranging from CEOs to environmental and R&D managers. The companies included three large companies from both energy and wood industries, two large companies from process industry, one large company from steel, waste-management and digital business industries. In addition, the data were gathered from one large and one medium-sized consulting organizations focusing on regional business development.

Sustainable development has a mature role in Finnish companies, authorities, consumers and the society. The interviewed firms had a long history of sustainability reporting and had introduced sustainability-related products, such as bio-oil and materials to replace plastic packaging of food. While systemic innovations require collaboration between science, government, industry and civil society, the study focuses on exploring the perceptions of firms to create deeper understanding of their perspectives.

Through open-ended interview questions, the participants were asked to express their feelings on how sustainability was concerned in their business development and innovation activities. More specific questions were asked to identify the challenges, problems, tensions and uncertainties of executing sustainability innovations. In addition, the interviews concerned the future needs and challenges to execute more innovations for sustainability.

The data analysis followed content analysis methods with open coding to understand the managerial challenges in making sustainability-related decisions. During the coding, we noticed recurring themes including (1) external factors (i.e., structural impediments), (2) internal decision-making factors (leading to uncertainty avoidance) and (3) increased complexity (due to conflicting aims). The data analysis was continued by employing cross-case analysis and axial coding (Corbin and Strauss 2015) to focus on specific sustainability innovation-related tensions and uncertainties. The analysis was founded on themes identified in the literature (see Table 9.1). The emerging results were presented to managerial and academic audiences (Yin 2014), after which we made minor iterations and clarified the identified groups of challenges.

Results—Synthesis of the Perceived Key Challenges

We found that the challenges identified by scholars could be positioned into three categories: (1) structural impediments, (2) uncertainty avoidance and (3) conflicting aims within and between firms. Some challenges were interlinked and overlapped between categories. The challenges identified in the literature are synthesized in Table 9.1. This table is complemented with empirical insights from our data with the focus on related effects on innovation management. The literature led our empirical research to understand where capabilities fall short in managing systemic innovation for sustainability.

Structural impediments include challenges related to market structures and infrastructure. The incumbent actors' dominance on markets, together

Table 9.1 Overview of the challenges of delivering systemic innovations for sustainability

Challenge categories: theoretical insights	The effects on innovation management: empirical insights	Empirical insights
	Structural impediments	
Market structure Infrastructure challenges Institutional and regulatory challenges Financial capital availability challenges	Dominating incumbents focus on incremental market innovations that fit existing structures. Institutional misalignment between different government levels and sectors causes adoption challenges for innovation.	There is much debate between different actors inside industries about the sustainability of different choices (e.g., related to wood as construction material). This debate has not always stayed on facts as companies defend their own business perspectives instead of seeing the overall sustainability benefits.
Key literature sources: Anttonen et al. (2013), Boström et al. (2015), Mignon and Bergek (2016), Mylan et al. (2015)		When viewed on a European level, regulatory environments can be misaligned and confusing, such as with of the classifications of renewable materials that vary between countries (e.g., peat is classified in Sweden as a renewable material, and in Finland, it is not).

(continued)

Table 9.1 (continued)

Challenge categories: theoretical insights	The effects on innovation management: empirical insights	Empirical insights
	Uncertainty avoidance	
High investment costs Technological and commercial uncertainty Regulatory uncertainty Organizational uncertainty Social uncertainty *Key literature sources*: Ambec and Lanoie (2008), Anttonen et al. (2013), Hall et al. (2011), Mignon and Bergek (2016), Noppers et al. (2015), Lopez et al. (2017), Silvestre (2015), Vezzoli et al. (2015)	Innovations for sustainability are expensive by traditional measures, leading to high opportunity costs. Regulatory uncertainty prevents investment decisions. Discontinuity of political decisions and changing policies create outcome uncertainties. New technologies involve risks (economic, social, environmental) and high uncertainty, as they lack references. Sustainability demands and innovation actions create costs, but benefits are hard to valuate financially, making project-level profitability comparisons difficult.	Respondents see high political risks as politics and regulations related to sustainability may change (fast). Political changes may lead to a loss of operation conditions. There exists a technological dilemma as old technologies are not sustainable enough. However, new technologies lack references, which is why companies are not permitted to put new technologies into action. The society needs sustained profitable economic activity to function, but companies (and societal actors) find it hard to estimate the economic sustainability of the sustainability investments.

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Table 9.1 (continued)

Challenge categories: theoretical insights	The effects on innovation management: empirical insights	Empirical insights
	Conflicting aims within and between firms	
Conflicts for business timeframes	Existing performance measures, decision structures and practices are geared for a shorter business timeframe.	Companies are impatient with waiting for results of sustainable development initiatives (e.g., monetary benefits) that are not visible in the short term.
Conflicts between actors' perceptions	Deciding between contradictory sustainability goals and opportunity costs hinders innovation actions.	Social and economic sustainability goals can be contradictory and the interpretation of responsibility may vary between actors (e.g., societal actor and company representative).
Increased complexity of networks	Increased dependency on suppliers and networks requires identification and management of partners' capabilities and involvement. In global networks, geographical and cultural gaps complicate matters further.	Companies and organizations need active and knowledgeable partners to sustainability initiatives, but higher level sustainability goals are weakly implemented in many companies.
Interaction and communication challenges	Focusing on internal business goals obstructs collaborative innovation.	There is a need to increase information about possibilities for collaboration and innovation in terms of sustainability. Especially SMEs lack knowledge of what is being done in other companies and universities.
Information and knowledge gap challenges	Communication challenges lead to commercial uncertainties and an inability to leverage sustainability innovations.	
Key literature sources: Boström et al. (2015), Eccles et al. (2014), Gaziulusoy and Brezet (2015), Hahn et al. (2010), Lockett et al. (2011), Mignon and Bergek (2016), Mylan et al. (2015), Roscoe et al. (2016), Quist and Tukker (2013)	Information and knowledge gaps hinder interorganizational learning and innovative collaboration.	

with the increased supply network coordination, promotes the stability of existing businesses, setting focus on incremental development (Mylan et al. 2015). Lack of knowledge, physical infrastructures and financial capital hold back innovations as well (Mignon and Bergek 2016). Institutional misalignment, varying standards and informal institutional challenges may impede innovation further (Mignon and Bergek 2016; Boström et al. 2015). Structural impediments were largely seen by the interviewees to be beyond the direct influence of firms. Still, the firms were aware of the institutional environment and adapted their activities accordingly.

Innovation for sustainability often involves high technological and commercial uncertainty related to a lack of available knowledge, resources, competencies and capabilities (Vezzoli et al. 2015). For instance, companies' or supply chains' lacking resources create challenges in technological feasibility (Hall et al. 2011), while individual adopters' resources and behavior influence their willingness to pay for innovation (Noppers et al. 2015; Anttonen et al. 2013).

Uncertainty avoidance is linked to high investment costs (Ambec and Lanoie 2008) and unpredictable regulatory environments (Lopez et al. 2017). Organizational uncertainty comes also from matching sustainability with other strategic goals and from challenges in seeing the societal side effects (Hall et al. 2011; Silvestre 2015).

Our empirical results showed that uncertainty avoidance was strong in holding back investments in systematic innovation for sustainability. As informants explained, the ideas exist but the willingness to take the business risks is missing. Firms favor more traditional projects where returns are perceived to be more reliable. As an example of this risk aversion, one informant had discontinued piloting a new bio-heating plant because they wanted to be certain that their solutions work perfectly from technical and commercial perspectives without needing to invest in testing and development. Political uncertainty at European, national and regional levels complicates sustainability investments and the implementation of sustainable innovations. The informants noted especially that compliance with the external demands (regulations) might simply be too expensive or demanding to execute. To anticipate ever-tightening regulations, some firms have their suppliers follow more stringent environmental standards than the authorities do. Still, most firms simply avoid unclear regulatory environments and refrain from non-mandatory sustainability investments. The uncertain but strong political influence polarizes sustainability investments to patterns of over- and underinvestment.

Conflicting aims within and between firms are linked to conflicts between the actors' perceptions (Hahn et al. 2010) and increased dependency on networks with a variety of actors, relationships and different incentives and objectives (Lockett et al. 2011; Eccles et al. 2014). These are closely connected to challenges in interaction and communication (Mignon and Bergek 2016; Roscoe et al. 2016; Quist and Tukker 2013), information asymmetry and lack of transparency between actors, which may lead to suboptimal coordination and learning (Boström et al. 2015). Furthermore, sustainability innovations are characterized by challenges in coping with short-term business goals and long-term objectives (Gaziulusoy and Brezet 2015).

All the companies in our study acknowledged that some sustainability efforts are needed to maintain a 'license to operate,' and that sustainability has a definite impact on investment priorities. However, this was often seen as sacrificing financial performance to satisfy sustainability goals. Furthermore, the companies saw that systemic effects were neglected also by the authorities as they often forget cross-effects and put efforts especially on activities that are currently present in the media or by political actors. The notions of sustainability may differ greatly among the involved actors and managing divergent stakeholder interests was claimed to be exceedingly challenging in complex networks. Managers acknowledged the importance of interfirm cooperation, but admitted that most sustainability actions were still internal, without a connection to the actions or strategies of their stakeholders. Therefore, cooperative open innovation capabilities were underdeveloped. Communication challenges also hamper firms' abilities to capture value from sustainability projects, and information and knowledge gaps exacerbate many of the problems.

The three categories presented above correspond to a division to external (industry-level) factors, internal factors that complicate decision-making and relational factors in stakeholder interaction. While firms are experienced in applying dynamic capabilities for internal resource reconfiguration and environmental alignment, the pursuit of systemic innovations challenges the familiar conceptions of firm boundaries. Firms need to cope with extending the breadth and depth of interaction with their business environment, which may be beyond their current capabilities.

The results paint a picture of self-reinforcing conditions of inertia that work against the transformation toward systemic sustainability in innovation practices. The market is structured to favor incremental development and stability over building radical innovation capabilities while interaction and communication challenges complicate concerted efforts and collaborative innovation. With such adverse conditions, navigating the transition toward systemic innovations for sustainability requires dedicated strategic action and capability building.

Organizational Roots of Inaction

Our initial content analysis showed how firms were struggling with transforming sustainability from a marginal add-on to a systemic strategy. They saw benefits in systemic sustainability for innovation, but hesitated to invest due to a perceived lack of information and understanding of sustainability interactions, associated costs and outcomes. In other words, we found empirical support for the previously understood challenges with systemic innovation for sustainability.

Sustainability development can be described as a shift in business strategy from a single-bottom line to a triple-bottom line (Elkington 1997) and now increasingly to the multi-dimensional systems approach (Adams et al. 2016). While the transition to the triple-bottom line already added environmental and community impacts to be considered as business outputs, the systemic view forces firms to strategize and act in new ways. Firms need to be increasingly context-specific and networked, focusing on engaging external stakeholders (e.g., Silvestre 2015) and improving entire systems (Adams et al. 2016). In the systemic view, sustainability business lies in a complex web of influential actors.

The perceived challenges are amplified in transitioning to a systemic approach, as the idiosyncratic characteristics of systemic innovation for sustainability challenge former capabilities in novel ways. As profitable systemic innovation opportunities are nested in a web of stakeholder interactions and may require radical innovation, sensing and seizing opportunities involve greater uncertainty, collaborative effort and reconfiguration of organizational resources. The influence of undeveloped capabilities manifests as decision-making problems in the outcomes and alternatives of evaluating innovation projects throughout the innovation process, and communicating them to capture the intended value, as illustrated in Fig. 9.1.

Even given sufficient awareness and strategic emphasis on transitioning to systemic innovations for sustainability, uncertainty avoidance may lead organizations to falter in building such innovation capabilities and acting on sustainable innovation strategies. Difficulties

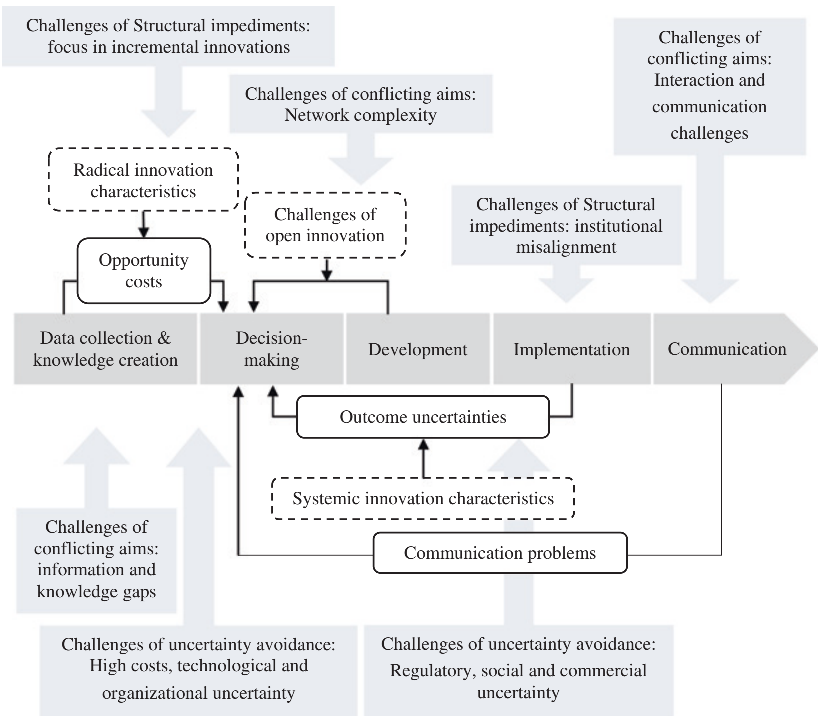

Fig. 9.1 Decision-making challenges in innovation for sustainability

in valuation of systemic innovations for sustainability, uncertainty of financial returns and technologies create outcome uncertainties that increase decision-making inconvenience. High investment costs manifest also as opportunity costs. Furthermore, institutional misalignment together with social and commercial uncertainty hampers the adoption and implementation of systemic innovations.

Decisions regarding systemic innovations for sustainability encounter cumulative issues across the innovation process. Companies are facing situations where they are required to invest without sufficient information and means to evaluate these projects versus other investments, i.e., not being able to evaluate the opportunity costs. The more radical the nature of the innovation is, the more it encounters inertia in the business environment, and displaces existing lines of business and business models, which are all difficult to account for. Systemic innovations also depend on the actions of the stakeholders, the management of which requires specific open innovation capabilities, such as networking, competence mapping, and relational and desorptive capabilities (Behnam et al. 2018). Finally, the captured value of the innovation is tied to communication capabilities as well, adding to the uncertainty about the outcome.

The cumulative nature of the challenges involved in delivering systemic innovations for sustainability may lead companies to focus on improving the wrong areas. Instead of building capabilities that would address the root issues—improving the innovation decision-making capacity to cope with uncertainty, stakeholder management and complexity—they may end up focusing on patching the symptomatic results of these by addressing individual phases or activities of the innovation process.

Conclusion

Our study of 13 companies from seven industries showed that firms' capabilities are yet to catch up with the unique demands set by systemic innovations for sustainability. To acquire the appropriate capabilities, firms should focus on building adaptive learning capacities and redesign processes to accommodate extensive uncertainty and collaboration, e.g., by integrating end users into innovation processes (Zimmerling et al. 2017).

This builds organizational resilience and positions firms as complex adaptive organisms (Inigo and Albareda 2016). Such a mind-set will accelerate systemic innovations—not only by gaining confidence to act in uncertainty, but also by increasing the potential for radical and business model innovations through focus on the unexpected. Building capabilities for systemic innovation for sustainability is challenging, as best practice examples are not readily available. However, developing capabilities for open and radical innovation could help to address the challenges.

The literature and empirical findings show how issues of structural impediments, uncertainty avoidance and conflicting aims within and between the firms all contribute to the inaction and indecision witnessed in pursuing systemic innovations for sustainability. Even in firms with a strategic commitment to sustainability, innovation processes and capabilities are not yet developed to support the kinds of radical, systemic and collaborative actions required to make the transition. Organizations find themselves facing conditions that incentivize inertia in the transformation and succumb to uncertainty avoidance behaviors that can only be overcome by decisive management action.

This study encourages company and governmental decision-makers to invest in innovation- and sustainability-related education. Increasing the knowledge, understanding of the requirements and the development of skills (e.g., to evaluate and communicate sustainability value) in companies and among political decision-makers are a key in increasing the collaboration required for systemic innovations for sustainability. This helps in defining congruent goals between the actors and encouraging collaboration and open innovation, through which the risks of radical innovations may be lowered.

While we focused on the perceptions of leaders in large multinational companies, studying SMEs could yield complementary insights. Smaller firms have different innovation capabilities and have fewer complementary assets to support large-scale innovation projects. On the other hand, SMEs, in competition with incumbents, are more agile and (by necessity) willing to risk more with exploratory and innovative approaches. The needs for capability development could also be different for SMEs. This provides an interesting avenue for future research.

Also, given that systemic innovation, by definition, involves multiple actors, further research following the Triple Helix concept (Etzkowitz and Leydesdorff 2000) could discover effective policy options by explaining the systemic reactions that currently lead to unfavorable lock-in situations (Wesseling and Van der Vooren 2017).

References

Accenture. 2015. "Special edition: A call to climate action". The UN Global Compact-Accenture CEO Study. Accessed May 25, 2018. https://www.unglobalcompact.org/library/3551.

Adams, Richard, S. Jeanrenaud, J. Bessant, D. Denyer, and P. Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International journal of Management Reviews* 18 (2): 180–205.

Ambec, Stefan, and P. Lanoie. 2008. "Does it pay to be green? A systematic overview." *Academy of Management Perspectives* 22: 45–62.

Anttonen, Markku, M. Halme, E. Houtbeckers, and J. Nurkka. 2013. "The other side of sustainable innovation: Is there a demand for innovative services?" *Journal of Cleaner Production* 45: 89–103.

Behnam, Sarah, R. Cagliano, and M. Grivaljo. 2018. "How should firms reconcile their open innovation capabilities for incorporating external actors in innovations aimed at sustainable development?" *Journal of Cleaner Production* 170: 950–65.

Bocken, Nancy, S. Short, P. Rana, and S. Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, C. Montalvo, J. Quist, and M. Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Boström, Magnus, A. Jönsson, S. Lockie, and A. Mol. 2015. "Sustainable and responsible supply chain governance: Challenges and opportunities." *Journal of Cleaner Production* 107: 1–7.

Corbin, Juliet, and A. Strauss. 2015. *Basics of qualitative research: Techniques and procedures for developing grounded theory*. 4th ed. Newbury Park, CA: Sage.

Eccles, Robert, I. Ioannou, and G. Serafeim. 2014. "The impact of corporate sustainability on organizational processes and performance." *Management Science* 60 (11): 2835–57.

Eisenhardt, Kathleen, and M. Graebner. 2007. "Theory building from cases: Opportunities and challenges." *Academy of Management Journal* 50 (1): 25–32.
Eisenhardt, Kathleen, and J. Martin. 2000. "Dynamic capabilities: What are they?" *Strategic Management Journal* 21: 1105–21.
Elkington, John. 1997. *Cannibals with forks: The triple bottom line of sustainability*. Gabriola Island: New Society Publishers.
Etzkowitz, Henry, and L. Leydesdorff. 2000. "The dynamics of innovation: From National Systems and 'Mode 2' to a Triple Helix of university–industry–government relations." *Research Policy* 29 (2): 109–23.
Gaziulusoy, A. Idil, and H. Brezet. 2015. "Design for system innovations and transitions: A conceptual framework integrating insights from sustainability science and theories of system innovations and transitions." *Journal of Cleaner Production* 108: 558–68.
Hahn, Tobias, F. Figge, J. Pinkse, and L. Preuss, L. 2010. "Trade-offs in corporate sustainability: You can't have your cake and eat it." *Business Strategy and the Environment* 19: 217–29.
Hall, Jeremy, S. Matos, B. Silvestre, and M. Martin. 2011. "Managing technological and social uncertainties of innovation: The evolution of Brazilian energy and agriculture." *Technological Forecasting and Social Change* 78 (7): 1147–57.
Hansen, Erik G., F. Grosse-Dunker, and R. Reichwald. 2009. "Sustainability innovation cube—A framework to evaluate sustainability oriented innovations." *International Journal of Innovation Management* 13 (4): 683–713.
Helfat, Constance, and M. Peteraf. 2003. "The dynamic resource-based view: Capability lifecycles." *Strategic Management Journal* 24: 997–1010.
Inigo, Edurne, and L. Albareda. 2016. "Understanding sustainable innovation as complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.
Lichtenthaler, Ulrich. 2011. "Open innovation: Past research, current debates, and future directions." *Academy of Management Perspectives* 25 (1): 75–93.
Lichtenthaler, Ulrich, and E. Lichtenthaler. 2009. "A capability-based framework for open innovation: Complementing absorptive capacity." *Journal of Management Studies* 46 (8): 1315–38.
Lin, Yuan-Hsu, and M.-L. Tseng. 2016. "Assessing the competitive priorities within sustainable supply chain management under uncertainty." *Journal of Cleaner Production* 112: 2133–44.
Lockett, Helen, M. Johnson, M. Bastl, and S. Evans. 2011. "Product service systems and supply network relationships: An exploratory case study." *Journal of Manufacturing Technology Management* 22: 293–313.

Lopez, Rodriguez, A. Sakhel, and T. Busch. 2017. "Corporate investments and environmental regulation: The role of regulatory uncertainty, regulation-induced uncertainty, and investment history." *European Management Journal* 31 (1): 91–101.

Lozano, Rodriguez. 2015. "A holistic perspective on corporate sustainability drivers." *Corporate Social Responsibility and Environmental Management* 22(1): 32–44.

Markad, Jochen, R. Raven, and B. Truffer. 2012. "Sustainability transitions: An emerging field of research and its prospects." *Research Policy* 41: 955–67.

Medeiros, Janine, J. Ribeiro, and M. Cortimiglia. 2014. "Success factors for environmentally sustainable product innovation: A systematic literature review." *Journal of Cleaner production* 65: 76–86.

Mignon, Ingrid, and A. Bergek. 2016. "System- and actor-level challenges for diffusion of renewable electricity technologies: An international comparison." *Journal of Cleaner Production* 128: 105–15.

Mylan, Josephine, F. Geels, S. Gee, A. McMeekin, and C. Foster. 2015. "Eco-innovation and retailers in milk, beef and bread chains: Enriching environmental supply chain management with insights from innovation studies." *Journal of Cleaner Production* 107: 20–30.

Nidumolu, Ram, C. Prahalad, and M. Rangaswami. 2009. "Why sustainability is now the key driver of innovation." *Harvard Business Review* 8 (9): 56–64.

Noppers, Ernst, K. Keizer, M. Bockarjova, and L. Steg. 2015. "The adoption of sustainable innovations: The role of instrumental, environmental, and symbolic attributes for earlier and later adopters." *Journal of Environmental Psychology* 44: 74–84.

Quist, Jaco, and A. Tukker. 2013. "Knowledge collaboration and learning for sustainable innovation and consumption: Introduction to the ERSCP portion of this special volume." *Journal of Cleaner Production* 48: 167–75.

Roscoe, Samuel, P. Cousins, and R. Lamming. 2016. "Developing eco-innovations: A three stage typology for supply networks." *Journal of Cleaner Production* 112: 1948–59.

Schaltegger, Stefan, and M. Wagner. 2011. "Sustainable entrepreneurship and sustainability innovation: Categories and interactions." *Business Strategy and the Environment* 20 (4): 222–37.

Schiederig, Tim, F. Tietze, and C. Herstatt. 2012. "Green innovation in technology and innovation management—An exploratory literature review." *R&D Management* 42 (2): 180–92.

Seebode, Dorothea, S. Jeanrenaud, and J. Bessant. 2012. "Managing innovation for sustainability." *R&D Management* 42(3): 195–206.

Silvestre, Bruno. 2015. "A hard nut to crack! Implementing supply chain sustainability in an emerging economy." *Journal of Cleaner Production* 96: 171–81.

Slater, Stanley, J. Mohr, and S. Sengupta. 2013. "Radical product innovation capability: Literature review, synthesis, and illustrative research propositions." *The Journal of Product Innovation Management* 31 (3): 552–66.

Teece, David. 2007. "Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance." *Strategic Management Journal* 28: 1319–50.

Teece, David. 2017. "Business models and dynamic capabilities." *Long Range Planning* 51 (1): 40–49.

Teece, David, G. Pisano, and A. Shuen. 1997. "Dynamic capabilities and strategic management." *Strategic Management Journal* 18: 509–33.

Van den Bosch, S. J. M., J. Brezet, and P. Vergragt. 2015. "How to kick off system innovation: A Rotterdam case study of the transition to a fuel cell transport system." *Journal of Cleaner Production* 13: 1027–35.

Vezzoli, Carlo, F. Ceschin, J. Diehl, and C. Kohtala. 2015. "New design challenges to widely implement 'Sustainable Product-Service Systems'." *Journal of Cleaner Production* 97: 1–12.

Wesseling, Joeri H., and A. Van der Vooren. 2017. "Lock-in of mature innovation systems: The transformation toward clean concrete in the Netherlands." *Journal of Cleaner Production* 155: 114–24.

Winter, Sidney. 2003. "Understanding dynamic capabilities." *Strategic Management Journal* 24: 991–95.

Xavier, Amanda, R. Naveiro, A. Aoussat, and T. Reyes. 2017. "Systematic literature review of eco-innovation models: Opportunities and recommendations for future research." *Journal of Cleaner Production* 149: 1278–302.

Yin, Robert. 2014. *Case study research: Design and methods.* 5th ed. Thousand Oaks, CA: Sage.

Zimmerling, Eric, H. Purtik, and I. Welpe. 2017. "End-users as co-developers for novel green products and services—An exploratory case study analysis of the innovation process in incumbent firms." *Journal of Cleaner Production* 162: S51–S58.

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Toward Smart and Sustainable Business Models in Retail

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Introduction

The business models of the retail sector are under pressure. Several factors force retail companies to think in completely new ways about how to create, deliver and capture value: The sustainability challenges associated with a massive footprint along global value chains both related to resource usage and emissions; digitalization and automation; disruptive innovations from new competitors; and evolving customer preferences and lifestyles.

Three main drivers—the technological opportunity space, the sustainability problem and expectations from customers—thereby drive the development of new business models. Retail companies face substantial

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sustainability problems (e.g., Rockström et al. 2009; Reinartz et al. 2011), but at the same time a rapidly expanding technological opportunity space (e.g., Schwab 2016) that can help solve the sustainability challenges. What will the future of retail look like, and how can companies align sustainability and profitability in the design of their future business models?

This chapter aims to investigate the types of business model innovation in the retail sector that can lead to smarter and more sustainable business models. Sustainability has long been considered a driver of innovation (Nidumolu et al. 2009), but as argued by Foss and Saebi (2017), there is need for further research on how managers can innovate their business models toward greater sustainability. Increasingly, the technological opportunities comprised in the digital and physical technologies often referred to as the fourth industrial revolution (Schwab 2016) have enabled the development of smarter and leaner business models. These business models can have a smaller footprint while remaining equally good customer experiences. Such business models are often based on access rather than ownership (Belk 2014), on modular, dematerialized and/or virtual solutions rather than physical ones (e.g., Bocken et al. 2016; Waage 2007), as well as new forms of consumption, sharing and reuse (see, e.g., Bocken et al. 2014; Botsman and Rogers 2010; Boons and Lüdeke-Freund 2013; Jørgensen and Pedersen 2018). Business models based on such ideas can potentially thrive in the future of retail.

The remainder of the chapter is structured as follows. First, we outline the background for why new business models are needed in retail. Second, we outline a framework—RESTART—that can be the basis for business model innovation for sustainability. Finally, we apply the framework to the retail sector in order to investigate what might be the characteristics of smarter and sustainable business models in retail.

Background

How many years will it take before we no longer own our own car, but rather subscribe to a shuttle service based on a fleet of driverless cars? How soon will we sit at home browsing social media through our virtual reality goggles, looking at clothes that are digitally customized to us, and we will simply talk to our browser and ask it to order a garment we like? Then, the garment is 3D printed and flown to our homes by a drone that picks it up from an unstaffed warehouse, while payment is executed automatically. When will we put our laundry in the washing machine and the clothes will have sensors that tell the machine the garments' washing instructions? For that matter: When will we be able to order 3D-printed spare parts to our washing machines, which are 3D printed and sent to us when needed? And how long until we get smart LED light bulbs and other products for free because they are linked to the Internet and are financed by generating valuable data about us to companies that benefit from this information?

Such scenarios, which may feel like science fiction, are becoming more science and less fiction. Just look at how quickly companies like Alibaba and Amazon have built their gigantic ecosystems online, through which they offer more products and services than what we thought possible only a short time ago. These technological changes are occurring at record speed, and current business models must consequently change rapidly (Teece 2010). The fourth industrial revolution is already ongoing and involves an almost all-encompassing transformation characterized by new technologies like artificial intelligence, robotics, the Internet of Things (IoT), 3D printing and new materials (Schwab 2016). It further comprises the emergence of autonomous vehicles, new forms of energy, genetic engineering, nanotechnology and drones (see, e.g., Kelly 2016).

In parallel with these technological developments, online solutions and platforms that bring together suppliers and demanders of goods and services also challenge traditional business models (Parker et al. 2016). Moreover, new sharing-economic and circular-economic business models deviate from conventional business thinking (see, e.g., Botsman and Rogers 2010; McDonough and Braungart 2010). Overall, these trends point toward a comprehensive transformation of current business models that imply new ways of producing, transporting, consuming and reusing materials, components and products. These smarter business models can enable more efficient resource use and customization of products and services in a way that can improve the offering to customers while reducing the footprint thereof.

Business models with such characteristics are crucial for achieving a sustainable future (cf. Schaltegger et al. 2016). Managers in the retail sector face many of the same challenges as do managers in other companies that want to design sustainable and profitable business models. In addition to the challenge of reducing its own negative footprint and increase its positive footprint, the retail sector is often the intermediary between producers and consumers, if we disregard the companies in this industry that are vertically integrated. Therefore, managers in the retail sector also have to take into account the footprint of manufacturers and customers when dealing with sustainability in their business models. Customers who experience negative health effects of the products they consume are also part of retailers' footprints (cf. Dorfman et al. 2012). And with increasing expectations of traceability (cf. Mol 2015), the burden of accountability on retail companies increases.

In order to align sustainability and profitability, however, sustainability efforts must be integrated into companies' business models (e.g., Eccles and Serafeim 2013; Jørgensen and Pedersen 2018; see also Porter and Kramer 2011). In order for sustainability efforts to translate into better business performance, however, the efforts must help the company increase revenues by customers who have a higher willingness to pay, contribute to more cost-effective delivery or in other ways increase the revenue or reduce the costs of the company (cf. Esty and Winston 2009). Recent studies show that such effects are possible to achieve, but that doing so requires appropriate prioritization of the sustainability issues that are most important to stakeholders and most critical to the company (e.g., Khan et al. 2016; Eccles et al. 2014). This requires systematic and strategic efforts. In the following, we will argue that this requires a *RESTART*.

RESTART: A Framework for Sustainable Business Model Innovation

In the following, we outline a framework—RESTART—that captures seven features of business models that we argue can be the basis for smarter and more sustainable business models. We have developed the framework inductively, through a combination of quantitative, qualitative and action-based research in close collaboration with companies in several sectors. Across several different research projects, we have collected data through structured and unstructured interviews with executives, managers and sustainability officers, which have formed the basis for deeper understanding of the kinds of changes companies are attempting to make to their business models. In addition, we have conducted surveys and field experiments with companies that also inform our account of the changes taking place and further business model innovations that might become widespread. Finally, we build on secondary data and information from reports, documents and scientific studies that have informed our understanding of the business modeling trends that are underway and that are likely to shape the business models of the future.

RESTART is an acronym of seven letters that correspond with seven features of more sustainable business models. They can meaningfully be categorized into three groups of features, and the framework was designed with these three in mind.

The first category, "RE"—*redesign* and *experimentation*, relates to the development that companies are increasingly faced with the need to redesign their business models (see, e.g., Johnson et al. 2008), which in turn necessitates controlled experimentation (Andries et al. 2013; McGrath 2010). The second category, "STA"—*service-logic*, *the circular economy* and *alliances*, reflects three central developments in contemporary business modeling for sustainability: the emphasis on services rather than products (or functionality rather than ownership; cf. Bocken et al. 2014), on circular business models rather than linear ones (see, e.g., Bocken et al. 2016; Linder and Williander 2017) and on alliances and collaboration rather than the single company competing in isolation (e.g., Kiron et al. 2015). The third category, "RT"—*results* and *three-dimensionality*, relates to the governance and control challenges associated with implementing a sustainable business model, which are crucial for its success (e.g., Eccles et al. 2014; Perrini and Tencati 2006).

We contrast each of the seven features with their opposites, all of which are arguably characteristics of business-as-usual. In this way, the framework highlights seven main changes that can make business models smarter and more sustainable:

REDESIGN rather than standstill
EXPERIMENTATION rather than turnaround
SERVICE-LOGIC rather than product-logic
THE CIRCULAR rather than the linear economy
ALLIANCES rather than solo-runs
RESULTS rather than indulgences
THREE-DIMENSIONALITY rather than one-dimensionality

The seven features outlined here can be defined as follows:

- **Redesign** refers to changes in business models that alter their value propositions and business-logic in a way that typically leads to new products, services or product-service systems (Schaltegger et al. 2012).
- **Experimentation** refers to a discovery-driven approach to business model design and implementation, in which companies conduct experimental tests of business model characteristics such as prices, value offerings (cf. McGrath 2010).
- **Service-logic** refers to understanding all economic exchanges as services, i.e., emphasizing processes, patterns and benefits of exchanges (i.e., services) rather than the outputs that are exchanged (i.e., goods) (Vargo and Lusch 2004).
- **The circular economy** refers to an economic model that is based on closing loops (circularity), narrowing loops (eco-efficiency) and slowing loops (longer product life cycles), and business models that build on such objectives (cf. Bocken et al. 2016; Stahel 2016).
- **Alliances** refers to companies' collaboration with other companies to gain access to their resources and capabilities (Mowery et al. 1996).
- **Results** refers to companies' prioritization of material objectives that serve the needs of the company as well as its stakeholders (Eccles and Serafeim 2013).
- **Three-dimensionality** refers to the triple-bottom line of business performance, that is, social, environmental and financial performance dimensions (Elkington 2013).

The seven features build on the following logic: New business models are emerging across all sectors, and *redesign* of business models reflects new ways to create, deliver and capture value. To successfully redesign business models, it is necessary to identify and analyze what works and what does not. Rather than putting all eggs in the same basket, companies should rather *experiment* on the way to a new business model.

In many cases, sustainable business can be promoted by a *service-logic*, which is oriented toward giving the customer access to what he or she needs, rather than offering it in the form of a product based on ownership. All companies use resources and generate excess resources and waste from their operations. To become more sustainable, it can be helpful to think in terms of *the circular economy* in designing the way resources are acquired, processed, used and ultimately reused.

Solutions of the type that promotes circulation and service thinking will often require that companies enter into *alliances* with other organizations that may enable them to create and deliver value in this way. This enables exploitation of the complementarity between companies and even facilitates manufacturing, logistics or other processes that involve smarter use of resources than if companies do not cooperate. In order to set the right goals and to prioritize the right efforts that can promote sustainability and profitability, it is essential to emphasize the right *results*. This involves identifying key externalities and material sustainability concerns that are critical for corporate strategy and operations. To achieve these goals, the organization must be designed in a way that reflects *three-dimensionality*. This means reflecting social, environmental and economic objectives in organizational design, leadership and management control systems (cf. Eccles et al. 2014; Inigo et al. 2017).

"Restarting" the Retail Sector

A profitable and sustainable retail sector requires smarter manufacturing, logistics and transportation, packaging, consumption and reuse. This will require a redesign of business models, and in the following, we outline what a restart of the retail sector might entail.

Redesign: A number of new business models are already setting the standard internationally. Among the most prominent are the giants, Alibaba's online platform model that enables a tremendous amount of transactions in both B2B and B2C markets has set a new standard for online commerce and shows how those who become the preferred platform can capture a very large piece of the pie. For instance, Alibaba are involved in more than 80% of all retail transactions in the huge Chinese market. With its innovation Amazon Go, Amazon has recently transferred its success with automation online, back into the physical world. With automated stores based on the technological infrastructure of the IoT, automated warehouse operation and user-friendly apps that make the shopping experience simple and seamless, it perhaps points toward what future stores will look like. The business models of both Alibaba and Amazon have been redesigned not only with regard to what is offered to the customer, but also the entire scope of how this is delivered, with implications for employment, the nature of work, payment models and so on.

Experimentation: With regard to *experimentation,* the way forward to these advanced business models will require controlled trial and error. Already, major retail players like IKEA are experimenting with more self-service in their stores, and such store will likely design many pilots on the way to even more automation. Many grocery store chains, such as COOP, have developed apps that give customers discounts on their most frequently bought goods, which of course implies that the stores adjust their assortment of products. This will lead to regional differentiation in product ranges and will have implications for value delivery in other ways, for example, by requiring less comprehensive logistics. Nevertheless, companies need to experiment in a controlled way with such changes in business models, in order to measure the real impact of such measures on sales, cost and profits. By doing so, the companies can determine the ways in which they can improve their business models.

It is also tempting to look at IKEA's planned "sustainable store" as an experimental approach to envision the future of IKEA stores. The new store will be designed for maximum resource utilization and reuse, both in terms of energy consumption, water consumption and excess resources. It will be the size of conventional IKEA stores, but will be based on other concepts that help customers live more sustainable lives. Perhaps this is a "sketch" for how the other IKEA stores can change over time, but using a controlled experimental approach, IKEA can learn more about how such a business model may look, and what the success criteria are.

Service-logic: Applying *service-logic* can improve resource efficiency and reduce companies' footprints. The contemporary economy is arguably a service economy, and a prominent trend is the movement from transactions based on ownership (in which goods are exchanged between the company and its customers) to transactions based on access (in which the customer only pays for access to the product or service). A good contemporary example is Tesla, which thinks of its cars as services rather than products. In the generation of Tesla cars, customers will be able to access each other's cars through an app. This makes it possible to rent your neighbor's car and pay for the use via the app. In the retail sector, many examples of comparable service-logic are emerging. Filippa K pioneered offering clothes as a service, meaning that customers could rent and return apparel. This is often done in conjunction with circular models in which fabrics are reused. Sharing-economic business models are also emerging in the clothing industry. Such companies are in fact a form of competitors to apparel stores, because they make it easy and attractive to reuse old products rather than buying new ones. However, is it appropriate for retail stores to incorporate sharing or rental models within their existing business models? This is a trade-off, since it could potentially generate revenue, but also incur costs that the companies would otherwise not bear. At least, it makes sense for retail companies to question which parts of their existing business model can be adapted to a service-logic. This can either involve going from selling products to selling access to products under a different payment model, or by changing their business models more radically by embracing models of the type mentioned above.

The circular economy: It is one of the most prominent business modeling trends for sustainability today. Its attractiveness is likely due to circular approaches being possible to implement at the micro-level as well as for an entire company. For example, Google has set an ambitious goal of becoming a "closed loop", in which there shall be no excess resources, energy or water coming out of its campuses. Instead, everything should be reused within a closed system. At the far end of the spectrum, there are small packaging-free shops such as Original Unverpackt in Berlin. These stores are not primarily circular concepts—they consist of a whole set of sustainability efforts.

Another example of efforts to increase circulation and reduce food waste is the grocery store SPAR's system for automatic price reductions for items approaching the expiration date. Such a system reduces waste and therefore the cost associated with waste management. In general, the technological opportunities tied to big data and predictive analytics hold great potential for inventory control and management through automated solutions. Such circular efforts are also widespread in the apparel industry, in which HM long ago adopted textile collection and recycling systems. Many companies now have collections of "circular clothes" produced by recycled apparel. Overall, we are hopefully moving toward a world in which there is no such thing as waste. Then, the competitive advantage lies in maximizing the utilization of resources and being innovative in finding ways to reuse excess resources repeatedly.

Alliances: To succeed with this type of restructuring, *alliances* with complementary partners is often necessary. In circular business models, this can involve partners that use each other's excess resources as input factors. With regard to service-logic, it may involve suppliers of digital infrastructure for new delivery or payment models. The Norwegian *Trippel* project has brought together different stakeholders from different industries, such as the food industry and the textile industry. Collaboration between manufacturers, suppliers, restaurants and other players in the food industry led to many pilots on how mutually beneficial collaborative ventures can make sense both from a value creation perspective and with regard to the reduction of footprints. Examples of projects that grew out of this collaboration were a joint logistics solutions for food manufacturers, systems for handling packaging in stores and other concepts intended to reduce food waste, promote healthy eating habits and so on. In order to tackle such challenges, we will likely see a greater prevalence of business model alliances across organizational boundaries.

Results: To achieve this, it is necessary to focus on *results* rather than indulgences. This implies emphasizing the material sustainability issues pertaining to business models. This is a question of prioritization, since all companies cannot solve all the problems they face. For example, Marks & Spencer recently communicated to its suppliers that it would require a certain percentage of recycled plastic in all its products. This is a decision related to very significant input factors for these companies, which results in an improvement in their footprints.

Such materiality analyses involve assessing the importance of sustainability issues for the company itself and for its stakeholders. Specifically, it makes sense to prioritize the sustainability issues that are important both for the company and its stakeholders—a point that sounds trivial, but which has substantial performance implications for companies that manage to do so (cf. Khan et al. 2016). The challenge is to monitor the sustainability issues that are become material—an analysis like this will of course be anything but static. The palm oil problem faced by food producers in recent years is a good illustration. The palm oil issue was not initially seen as central to the companies' operations, but it quickly became highly material when the public conversation centered on palm oil. Therefore, managers should ask "what is the next palm oil?", since it is a question of monitoring the sustainability issues that may become important for their companies' performance.

Three-dimensionality: Finally, with regard to *three-dimensionality*, companies need to be designed in a way that makes them capable of changing in the ways outlined above. This involves measurement of the right kinds of performance, organizing to achieve the right kinds of goals and designing incentives that can promote such performance. And not least, it involves the technologies that make such performance possible. It is predicted that traceability will be one of the major trends in retail in the years to come. This implies that one can trace products, components, even materials throughout the supply chain, thereby being able to know where they came from, what kind of footprints they have with regard to logistics, and the conditions under which they have been produced. Companies like IKEA and Puma are pioneering such efforts, but it will require a technological infrastructure that allows for measurement, sharing and analysis of information. In stores, this might enable labels that can be scanned for complete information about products' three-dimensional properties—price, social footprint and environmental footprint. This will render customers capable of making informed choices in the store based on such information.

Conclusions

In this chapter, we have argued that there are indications that we can be moving toward an economy in which the retail sector will have a smaller footprint, higher resource efficiency, greater degree of digitization and automation, greater transparency and traceability, and even greater focus on the customer experience. Based on the trends and drivers we have pointed out, we have argued that comprehensive changes in business models are necessary in order to develop a sustainable economy.

We have argued that these comprehensive changes toward more sustainable business models require what we denote a "RESTART" of business models. Importantly, however, such a restart is not a uniform set of measures—a "one-size-fits-all" recipe for all companies across all industries. Rather, the RESTART framework outlines seven avenues toward more sustainable business models that to varying degrees can inspire or shape future business models in different industries. While some companies could benefit from innovating toward a more circular business model that implies the reuse of materials and components in production, others could for instance be inspired by service-logic to move from an emphasis on the manufacturing and sale of physical products to digital services that solve the same problem for its customers.

Thus, the RESTART framework operates at a higher level of abstraction, in the sense that it brings together several different business modeling trends and developments that may lead us toward more sustainable business. As shown throughout the chapter, more in-depth analyses of such business models (e.g., circular business models, service-based or access-based business models) can be found in various strands of the literature on sustainable business and innovation.

The RESTART framework directs attention to the crucial interrelationship between various aspects of such business modeling trends. For instance, the transformation to business models based on access to services rather than ownership of products will require a keen ability for business model experimentation on the part of companies. Similarly, it seems likely that the ambitious goals for a more circular future will require cross-sector alliances through which companies can build business models that span across organizational boundaries in order to ensure higher resource efficiency and reuse. The RESTART framework reflects this interrelated nature of business model innovations related to value creation, delivery and capture.

While the RESTART framework is not sector-specific, the scope of this chapter has been to investigate what a smarter and more sustainable retail sector might look like. There is, however, a long way to go in order to attain this goal, and research studies in collaboration with the industry are necessary. We propose that future research on the business models of retail should investigate several business model aspects. First, the future of retail is likely to become more circular, as suggested by, e.g., IKEA's recent pledge to adopt a circular business model. In this regard, there is clearly a need for studies of the implications for product design and distribution, but equally important are studies of the payment models that can accompany such business models. This is a fruitful area for field experimental work. Second, the convergence of sustainability challenges and digitalization discussed above suggests that retail is becoming increasingly digital and oriented toward e-commerce. Could this transformation perhaps be an opportunity for using new customer interfaces to stimulate more sustainable consumer behavior? For instance, how could companies "nudge" consumers to choose greener products? These, and several other questions, are central to retail companies' attempts to contribute to a more sustainable future.

References

Andries, Petra, Koenraad Debackere, and Bart Van Looy. 2013. "Simultaneous experimentation as a learning strategy: Business model development under uncertainty." *Strategic Entrepreneurship Journal* 7 (4): 288–310.

Belk, Russell. 2014. "You are what you can access: Sharing and collaborative consumption online." *Journal of Business Research* 67 (8): 1595–600.

Bocken, Nancy M. P., Ingrid de Pauw, Conny Bakker, and Bram van der Grinten. 2016. "Product design and business model strategies for a circular economy." *Journal of Industrial and Production Engineering* 33 (5): 308–20.

Bocken, Nancy M. P., Samuel W. Short, Padmakshi Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Botsman, Rachel, and Roo Rogers. 2010. *"What's mine is yours." The rise of collaborative consumption*. New York: Harper.

Dorfman, Lori, Andrew Cheyne, Lissy C. Friedman, Asiya Wadud, and Mark Gottlieb. 2012. "Soda and tobacco industry corporate social responsibility campaigns: How do they compare?" *PLoS Medicine* 9 (6): e1001241.

Eccles, Robert G., and George Serafeim. 2013. "The performance frontier." *Harvard Business Review* 91 (5): 50–60.

Eccles, Robert G., Ioannis Ioannou, and George Serafeim. 2014. "The impact of corporate sustainability on organizational processes and performance." *Management Science* 60 (11): 2835–57.

Elkington, John. 2013. "Enter the triple bottom line." In *The triple bottom line*, 23–38. New York: Routledge.

Esty, Daniel, and Andrew Winston. 2009. *Green to gold: How smart companies use environmental strategy to innovate, create value, and build competitive advantage*. Hoboken, NJ: Wiley.

Foss, Nicolai J., and Tina Saebi. 2017. "Fifteen years of research on business model innovation: How far have we come, and where should we go?" *Journal of Management* 43 (1): 200–27.

Inigo, Edurne A., Laura Albareda, and Paavo Ritala. 2017. "Business model innovation for sustainability: Exploring evolutionary and radical approaches through dynamic capabilities." *Industry and Innovation* 24 (5): 515–42.

Johnson, Mark W., Clayton M. Christensen, and Henning Kagermann. 2008. "Reinventing your business model." *Harvard Business Review* 86 (12): 57–68.

Jørgensen, Sveinung, and Lars Jacob Tynes Pedersen. 2018. *RESTART sustainable business model innovation.* Cham: Palgrave.

Kelly, Kevin. 2016. *The Inevitable: Understanding the 12 technological forces that will shape our future*. New York: Penguin.

Khan, Mozaffar, George Serafeim, and Aaron Yoon. 2016. "Corporate sustainability: First evidence on materiality." *The Accounting Review* 91 (6): 1697–724.

Kiron, David, Nina Kruschwitz, Knut Haanaes, Martin Reeves, Sonja-Katrin Fuisz-Kehrbach, and Georg Kell. 2015. "Joining forces: Collaboration and leadership for sustainability." *MIT Sloan Management Review* 56 (3): 1–31.

Linder, Marcus, and Mats Williander. 2017. "Circular business model innovation: Inherent uncertainties." *Business Strategy and the Environment* 26 (2): 182–96.

McDonough, William, and Michael Braungart. 2010. *Cradle to cradle: Remaking the way we make things*. New York: North Point Press.

McGrath, Rita Gunther. 2010. "Business models: A discovery driven approach." *Long Range Planning* 43 (2–3): 247–61.

Mol, Arthur P. J. 2015. "Transparency and value chain sustainability." *Journal of Cleaner Production* 107: 154–61.

Mowery, David C., Joanne E. Oxley, and Brian S. Silverman. 1996. "Strategic alliances and interfirm knowledge transfer." *Strategic Management Journal* 17 (S2): 77–91.

Nidumolu, Ram, Coimbatore K. Prahalad, and Madhavan R. Rangaswami. 2009. "Why sustainability is now the key driver of innovation." *Harvard Business Review* 87 (9): 56–64.

Parker, Geoffrey G., Marshall W. Van Alstyne, and Sangeet Paul Choudary. 2016. *Platform revolution: How networked markets are transforming the economy and how to make them work for you*. New York: W. W. Norton.

Perrini, Francesco, and Antonio Tencati. 2006. "Sustainability and stakeholder management: The need for new corporate performance evaluation and reporting systems." *Business Strategy and the Environment* 15 (5): 296–308.

Porter, Michael E., and Mark R. Kramer. 2011. "The big idea: Creating shared value." *Harvard Business Review* 89 (1): 2.

Reinartz, Werner, Benedict Dellaert, Manfred Krafft, V. Kumar, and Rajan Varadarajan. 2011. "Retailing innovations in a globalizing retail market environment." *Journal of Retailing* 87: S53–S66.

Rockström, Johan, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin III, Eric F. Lambin, and Timothy M. Lenton et al. 2009. "A safe operating space for humanity." *Nature* 461 (7263): 472.

Schaltegger, Stefan, Erik G. Hansen, and Florian Lüdeke-Freund. 2016. "Business models for sustainability: Origins, present research, and future avenues." *Organization & Environment* 29 (1): 3–10.

Schaltegger, Stefan, Florian Lüdeke-Freund, and Erik G. Hansen. 2012. "Business cases for sustainability: The role of business model innovation for corporate sustainability." *International Journal of Innovation and Sustainable Development* 6 (2): 95–119.

Schwab, Klaus. 2016. *The fourth industrial revolution*. Geneva: World Economic Forum.

Stahel, Walter R. 2016. "The circular economy." *Nature News* 531 (7595): 435.

Teece, David J. 2010. "Business models, business strategy and innovation." *Long Range Planning* 43 (2–3): 172–94.

Vargo, Stephen L., and Robert F. Lusch. 2004. "Evolving to a new dominant logic for marketing." *Journal of Marketing* 68 (1): 1–17.

Waage, Sissel A. 2007. "Re-considering product design: A practical 'road-map' for integration of sustainability issues." *Journal of Cleaner Production* 15 (7): 638–49.

11

Business Model Innovation for Sustainability Through Localism

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Introduction

The world is facing social and environmental grand challenges that need to be tackled, and businesses can play an important role in this process as put forward in the introductory chapter of this book. To pursue sustainability or a triple bottom line, companies should integrate environmental and social considerations in their business models. These models are the architecture of how companies create, deliver, and capture value. To create sustainable value or shared value means that the business goal is not just to create profit for the shareholders, but to generate value for a broad range of stakeholders. Shared value is created through '*policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the*

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communities in which it (…) operates' (Porter and Kramer 2011: 66). It is about combining the self-interest of companies with societal improvements (Lüdeke-Freund et al. 2016).

Companies can explore various strategies or 'design themes' (Zott and Amit 2008) to innovate their business models for sustainability (e.g. Bocken et al. 2014; Clinton and Whisnant 2014). However, there are currently few case studies, which makes it challenging for companies to understand how sustainability-oriented innovation can be done (Evans et al. 2017).

This chapter will explore how pursuing localism can lead to innovation in business models for sustainability in the textile and fashion industry. Localism is *defined as a business strategy where companies try to establish a supply chain in geographic proximity while consciously taking into account local conditions in the business decisions*. The textile and fashion industry, considered to be one of the world's largest consumer industries, acknowledges the need to improve its unsustainable ways (Eder-Hansen et al. 2017). The current industry is highly global, characterised by long, linear, fragmented, and non-transparent value chains which appear to be challenging to trace for consumers, NGOs, and the industry itself. However, there are some companies that pursue localism as an alternative to the current global *modus operandi*. By taking a closer look at four Norwegian fashion companies that try to source and manufacture locally, this chapter will explore (1) how localism can contribute to innovation in the business models and (2) what shared value can be generated by companies pursuing localism.

Business Model Innovation for Sustainability

Business models are explained as the logic of how companies do business (Osterwalder and Pigneur 2010; Teece 2010; Magretta 2002). These models describe how companies capture, create, and deliver value (e.g. Zott et al. 2011). While value creation is about the products and services a company offers, value delivery is the resources and activities needed to deliver the value creation, and the value capture relates to how to earn revenues. A business model can be seen as a reflection of a company's strategy (Casadesus-Masanell and Ricart 2010), and any component of the business model can be innovated to be in line with the strategy.

Business model innovation is increasingly considered central for building sustainable businesses (e.g. Boons and Lüdeke-Freund 2013; Evans et al. 2017). Sustainability-oriented innovation calls for more integrated thinking and the reconfiguration of several business elements such as capabilities, stakeholder relationships, knowledge management, leadership, and culture (Adams et al. 2016). Stubbs and Cocklin (2008: 123) argue that '*organizations adopting a sustainable business model develop internal structural and cultural capabilities to achieve firm-level sustainability and collaborate with key stakeholders to achieve sustainability for the system that the organization is part of*'.

Companies can innovate towards sustainability through small incremental steps or through more radical, disruptive transformations (Adams et al. 2016; Inigo et al. 2017). Roome and Louche (2016) have found that more sustainable business models are developed through interactions between individuals and groups inside and outside the companies. The changes entail: (i) building networks and collaborative practices for learning and action around a new vision; (ii) adopting new ideas and concepts from outside the company; and (iii) developing and implementing a structure within a reconfigured network (ibid.).

Creating a sustainable business model implies sustainability-oriented innovation which is explained as a dynamic and unfolding process (Adams et al. 2016). It is often more complex than conventional innovation because the company must take into account often contradictory demands of a broad range of stakeholders (Hall and Vredenburg 2003). It is worth noting that sustainability can be thought of as an ideal and that business models cannot be entirely sustainable (Lozano 2018).

Bocken and her colleagues (2014) have identified eight archetypes which describe groupings of mechanisms and solutions that can contribute to the development of business models for sustainability. In the organisationally oriented archetype *Repurpose for society/environment* which entails '*close integration between the firm and local communities and other stakeholder groups*' (ibid.: 53), *localisation* is listed as an example under this archetype but is not presented further. In this chapter, the assumption is that localisation is related to localism and, therefore, a brief review of relevant literature follows.

Localism

At a general level, localism is a growing international trend focusing on re-establishing communities and protecting and rebuilding local economies (Hines 2013). It is about encouraging local livelihood through local production and consumption, and promotion of local identity. Localism can be considered a counter-movement to globalisation which has had economic, political, social, and ecological implications. Gray (2015: 57) argues that globalisation has '*uprooted activities and relationships from local origins and cultures*' and calls it '*de-localisation*'. Greater involvement from local communities has also been a highlighted path to promote sustainable development (ICLEI and IDRC 1996). Shrivastava and Kennelly argue that the '*grand project of sustainability will be given effect in places*' (2013). To illustrate the prevalence of localism, initiatives such as *Bioregional* (Desai and Riddlestone 2002) and *The Transition Town Movement* have been expanding internationally.

Hess (2009) argues that there has been relatively little academic reflection about localism. Still, there has been related research across various disciplines and different sectors, but not all this literature uses the term localism. In the field of rural development, a '*new rural paradigm*' is a counterforce to global competition logics in which a place-based focus embodies multifunctional agriculture and construction of identities linked to new rural goods and services (Horlings and Marsden 2014). The argumentation is that places have become increasingly 'place-less' due to reinforcing processes such as disconnection of producers, suppliers, and consumers and the goods and services (ibid.). There are also studies of local food systems (e.g. Marsden and Smith 2005; Jervell and Borgen 2004). Such local systems are claimed to be more sustainable since they have '*tight feedback loops*' which reconnect consumers, producers, and ecological effects and stimulates improvements based on continuous feedback (Sundkvist et al. 2005). Another field, economic geography, highlights that innovation depends on proximity factors and that local knowledge and capabilities are important to build sustainable competitiveness (e.g. Maskell and Malmberg 1999).

Taking localism down at a company level, it is useful to look at the supply chain and operation management literature, as well as publications in the field of corporate social responsibility. The outsourcing trend of the last decades has led to global supply chains that often include many suppliers and, thereby, easily end up being non-transparent. These supply chains can cover shady social and environmental practices that leave the focal company busy with assuring control of its suppliers. Supply chain management scholars highlight that focal companies are increasingly held responsible for their supply chain's problems (Seuring and Müller 2008). The companies that have outsourced to lower-cost countries have started to take into account that lower costs are accompanied by ethical problems such as '*poorer labour conditions, less environmental protection, and lower attention to health and safety protection*' (Crane and Matten 2016: 412). Thus, as corporate social responsibility scholars point out, outsourcing has been increasingly linked to problems outweighing the imposed cost savings (Carroll and Buchholtz 2012). As a result, the phenomena of reshoring (or backshoring, onshoring) is becoming increasingly evident in business practices (Fratocchi et al. 2014; Kinkel 2012) which refers to companies deciding to relocate their manufacturing to their home country.

Sustainable enterprising research has been criticised for being 'placeless', and that the relationship between companies and their *sense of place* (knowing and caring about a place) should not be overlooked when discussing the fostering of sustainable business behaviours (Shrivastava and Kennelly 2013; Guthey et al. 2014). The argument is that place-based enterprises '*offer a potentially important means of fostering ecological and social sustainability in local communities*' (Shrivastava and Kennelly 2013: 83).

In the recent years, the number of publications on the topic of localism as an approach to sustainable fashion has been slowly growing (e.g. Fletcher 2013; Black 2008). When discussing environmental stewardship and sustainable sourcing in fashion, Quinn (2008) argues that if a company wants to incorporate sustainability in its business, it must start out with an understanding of what products are made of and how they are produced. To accomplish sustainable sourcing, thorough knowledge of the supply chain is required. This involves closer contact with the different supply partners and other relevant stakeholders (ibid.), and this is best achieved at a local scale. Generally, '*actors in each other's proximity have fewer conflicts, more trust towards each other, […] and are thus more involved in knowledge transfer*' (Dolfsma and Eijk 2016: 271).

There is scarce research about place-based companies and their innovation journey (Kibler et al. 2015), and localism in the fashion and textile industry seems more like a recommended path than something that is empirically investigated. Therefore, this chapter will contribute to more empirical insights on business model innovation for sustainability through localism.

Method, Cases, and National Industry Context

To empirically explore localism in business models, a list of relevant Norwegian fashion companies was compiled through purposeful sampling. The chosen sampling strategy deliberately selects cases since they can supply data about the phenomenon of interest (Yin 2009). Through dialogue with various fashion industry contacts, the companies were identified based on the criterion that they had parts of or their whole supply chain in Norway.

Sample and Research context: Of the four small companies selected for this study, two are start-ups and two are incumbents, and all have owners who are involved in daily operations. The four cases share a sustainability focus and the pursuit of localism—by trying to establish a local supply chain, both regarding sourcing local fibres and material (mainly wool) and locating manufacturing activities in Norway. Data were gathered through interviews of the companies' managers/founders/owners at their offices and in their manufacturing facilities. These data were complemented with information derived from media coverage of the selected companies.

As place is naturally of importance in localism, one should also understand the cases' local context. After all, businesses do not develop independently; they are part of a community. For many years, Norway had a thriving textile industry based on wool, but this industry has undergone a decline since the 1950s (Espeli 1997). While the nation concentrated on building an oil-focused economy with high wages, many textile manufacturers were forced to outsource or shut down, leading to loss of jobs and industry knowledge (Hebrok et al. 2012). Consequently, the current industry situation can be characterised as incomplete from a supply chain perspective, and compared to other OECD-countries, the nation's textile and fashion industry has had little industrial importance for many decades (Espeli 1997).

Findings—Localism's Contribution to Innovation in the Business Models

With few local manufacturing partners available in Norway, two of the companies decided to invest in their own local factories. This implied innovation both in value creation and value delivery in their business models. Instead of doing design as the main business activity, they also included manufacturing in their business operations. The companies have experienced that in-house manufacturing stimulates innovation in the product design and manufacturing process (e.g. better utilisation of rest materials). To make the most out of the facilities, both expanded their value creation by offering different services at the factory. Company 1 offers manufacturing services to other fashion designers who want to produce locally and is also experimenting with additional services such as organising workshops for consumers in their factory after production hours. Company 2 has included a textile museum, a café, and a brand store in their facilities with the result of becoming an attraction for both tourists and other kinds of visitors.

Company 3 is a design studio which consciously seeks different local partners that can produce their designs. In their search, they came across a local shoe factory. Through dialogue, it became clear that the factory needed design expertise for the renewal of their collection. Therefore, the design studio expanded its value creation by offering design services and has experienced that this type of service is in demand by other local suppliers too. This innovation has led to increased income and altered revenue streams (part of the value capture). Also, it changes how the company collaborates with its partners, forming mutually beneficial partnerships with local suppliers.

As for sourcing local fibre, Company 4 changed its clothing collection to consist only of outerwear of local wool after they learned that Norwegian wool of the local sheep breeds is particularly suited for this type of wear. The company has been motivated to keep alive local craftsmanship and has had a close collaboration with local sheep-farmers, yarn makers, and weavers to develop the right kind of fabrics for their collections. Furthermore, the localism pursuit leads to innovation related to distribution, marketing, branding, and how the companies interact with their customers. Company 3 invites customers to events at their studio, and Company 1 organises workshops with consumers. These are multifunctional arenas where they can have a dialogue with customers (inform about their localism philosophy and get customer feedback that can be used to improve their collections), and they can sell their collections with higher earnings per product. Company 1 and Company 4, that have experience in production abroad, also find that a local supply chain allows shortened lead times, reduced costs related to customs and intermediaries, and ease of transport coordination. This has freed time and resources which they have invested in product improvements and the development of new business activities.

As presented earlier, all four companies want to source and manufacture in Norway, but in practice, they have encountered inhibiting industry conditions such as few remaining local manufacturing facilities in Norway and scarce supplies of local wool in the required quality. As a result, none of the companies has a completely local supply chain in Norway yet, but they are taking a step-by-step approach in their efforts to pursue localism. They seem to be encouraged by the challenge to revitalise the nation's textile and fashion industry and have a long-term perspective to get there. Meanwhile, they take a pragmatic approach, finding suppliers, and partners abroad, but look to the nearest possible shores such as the Baltics and other European countries, while they continuously search for opportunities and solutions that can give them a completely local supply chain (Table 11.1).

Table 11.1 The fashion companies' business *models*

	Value creation	Value delivery	Value capture
Company 1	• Offers durable wool products, mainly outerwear • Offers manufacturing facilities for other fashion companies • Offers fashion workshops for consumers	• Uses both locally and internationally sourced wool • In-house manufacturing which enables innovation and increases product quality • Uses fashion workshops to promote own designs • Distribution through factory store and other Norwegian and international stores	• Medium price range • Producing in line with sales rates reduces overabundance and cuts storage costs
Company 2	• Offers quality garments with a distinct design inspired by local culture • In-house museum and open factory with guided tours	• Sources European wool • In-house production of garments with modern knitting machines • International distribution through own stores + other selected stores	• High price range
Company 3	• Fashion items with a story • Organises art projects and exhibitions • Offers design, creative services, and project management for businesses	• Uses both local and internationally sourced fibre/fabrics • Collaboration with local partners with manufacturing facilities • Runs art projects at Norwegian art galleries which function as marketing arenas • Customer events at studio • Distribution through 'lifestyle stores' internationally	• Medium price range for the fashion products • Charges for consultancy services • Additional funding from art scholarships

(continued)

Table 11.1 (continued)

	Value creation	Value delivery	Value capture
Company 4	• Offers semi-customised woollen outerwear in a timeless design	• Sources local wool from local sheep breeds • Close collaboration with local suppliers in developing wool fabrics • Manufacturing in Europe • Organises customer events and pop-up stores	• Customers pay prior to production • Medium price range

Generating Shared Value Through Localism

The explorative case studies indicate that localism leads to innovation in the business models of the selected companies, but what shared value can companies pursuing this strategy generate? All the cases argue that localism generates shared value since local supply chains enable responsive dialogue with the various stakeholders. The geographic proximity shortens the feedback loops, increases the chances of being aware of issues in the local community, and reduces transport emissions. Company 4, which started to produce outerwear, learned that most of the woollen clothes worn by Norwegians are made of imported wool, while Norwegian farmers get little value, and even discard some of the wool from local sheep breeds (Hebrok et al. 2012). Since the local wool has distinct qualities such as lustre, long durability, and little moisture absorption, they started, in collaboration with the local suppliers, to develop woollen fabrics to be used in their outerwear collection. By choosing to source locally, the company not only makes use of a pesticide-free, renewable, and traceable fibre but contributes to increased income for local farmers. This also works as an incentive for the farmers to sustain local sheep breeds (supporting biodiversity). Moreover, these sheep help to cultivate the overgrown outfields in Norway caused by a decline of grassing herds.

For the two companies with their own manufacturing facilities, the experience is that in-house production gives more control of the manufacturing process which leads to improved product quality and more efficient use of resources. The improved quality can lead to longer garment life. These companies also find that they can produce according to demand, instead of being forced to order large batches often required by manufacturers overseas. This lowers the risk of overproduction and flooding of clothes on the market. This is good for both business and the environment. Furthermore, Company 2, which made its facilities into a tourist attraction, not only brings visitors to the local community but also makes use of the facility as an educational arena. They offer guided tours informing about all the processes needed on the journey from fibre to garment. The idea is that access to the production facilities can create greater awareness of clothing production which may stimulate more sustainable consumer behaviour.

The local factories create local manufacturing jobs and keep alive tacit industry knowledge. Company 4 also takes on fashion design apprentices to give them much-needed practical knowledge about clothing production. All the cases argue that their efforts to localise are motivated by their wish to help revitalise the national textile and fashion industry. They point out that a strengthened industry generates tax revenue which is shared value supporting the local welfare system. The overall effect is a contribution to building more resilient communities.

Discussion—Localism as a Strategy to Build Business Models for Sustainability?

The findings show that localism affects how the companies innovate different elements in their business models. The innovations happen evolutionarily through incremental changes in how the companies create, deliver, and capture value. This confirms sustainability-oriented innovation as a dynamic process (Adams et al. 2016) with experimentation and learning over time. The business model components are gradually changed, affected by enabling, and restricting factors in the local community. The companies are adapting '*the type of innovation they aim for to their particular context*' (Szekely and Strebel 2013: 467). The cases evolve new business models through dialogue with a reconfigured network of local suppliers (Roome and Louche 2016). Although each separate alteration can be small, the sum of the adaptions the companies undertake can, over time, considerably change the business model designs. For example, Company 1 originally did only fashion design but, by investing in a manufacturing facility, also became a manufacturing company that started to experiment with workshops for consumers.

The companies explored in this chapter pursue a local supply chain, but they still distribute and sell some of their products on the international market. Offering mainly niche products with a medium to high price (to cover the costs of producing in a high-cost country), their customer segments are not large enough on a local scale. Therefore, one can argue that the cases are presently somewhere in between global and local, in other words, some variant of 'glocal'. Hypothetically, companies pursuing localism with a circular economy mindset could also sell to local customers who use, repair and recycle locally. Such 'local circularity' could stimulate business model innovations that, if up-scaled, can lead to radical changes in the current global linear system with a high degree of underutilisation of textiles and garments (Ellen MacArthur Foundation 2017).

To discuss localism and generation of shared value, the data reveal that localism leads to innovation in the business models that create shared value of both environmental and social character as well as the value of self-interest to the cases (Lüdeke-Freund et al. 2016). The findings indicate shared value such as reduced transport emissions, use of environmentally friendly wool from local sheep breeds, creation of local jobs, and revitalisation of an industry. As a best case, localism can even extend product life cycles, especially if the companies succeed with their efforts to increase consumer awareness, in other words, tackles some of the unsustainable issues in the current global fast fashion industry. The geographic proximity seems to enable a reconnection between resources, people, place, community, and environment that correlates with sustainability. This reconnection makes it easier to understand different forms of value exchanges which are essential when designing a sustainable business model (Bocken et al. 2015). Being part of the same community also means that the stakeholders are more likely to have common cultural and communicational denominators, which increase the chances of tight and effective feedback loops (Sundkvist et al. 2005). The cases experience that localism increases the chances that stakeholders are more receptive towards each other since they are all part of the same community.

Does this mean that one can link localism to sustainability? Not necessarily, since not all companies with a local supply chain have a sense of place or a sustainability focus like the cases in this study. Thomas and Cross (2007) highlight that there are exploitative place-based companies who are neither rooted to nor embedded in place. One factor that increases the likelihood of the sense of place is company size. Smaller companies tend to have employees, managers, and owners who live in the same geographic location and, therefore, have a closer connection to the community (Darnall et al. 2010). The cases in this study are all small companies where the managers, who also are the owners, seem connected to their local community. However, that does not mean that large or even multinational companies do not have a chance to pursue localism. Porter and Kramer (2011) have proposed that the strongest global corporations in the future will be the ones that have developed a mutually beneficial collaboration with local suppliers and grown deep roots in local communities.

There are also darker sides of localism that should be addressed. When companies that pursue localism reshore their production, they cause loss of jobs elsewhere in the world. For the developing countries, reshoring will have the same effects as outsourcing has had in the developed world, closed businesses and factories with the result of lost jobs and decreased tax incomes that negatively affect the local welfare systems (Carroll and Buchholtz 2012: 558). What makes outsourcing worse for the developing countries, is that the fashion and textile industry can be one of the few employment opportunities for the population, meaning that this is a stakeholder group that can experience negative effects of the localism strategy. One should not overlook the unintended consequences, calling for responsible considerations by the companies that pursue localism. Responsiveness to stakeholders in the local community is good, but one should not forget to take international stakeholders into account too.

Conclusion

This chapter has explored the innovation of business models for sustainability through localism. The closer look at four Norwegian fashion companies shows that localism appears to be a potential strategy to build business models for sustainability. The various innovations in the business models are mostly incremental, but in sum and over time, can represent a substantial change in the companies' business models.

The findings also reveal that localism can increase the chances of generating shared value of various forms, but it entails that the companies must have a sensitivity to place and be rooted and embedded in its local community. The proximity enables more dynamic and responsive relations which increase the chances for a more even distribution of value. However, it is important to emphasise that this study has the companies' point of view. It is left to other studies to verify all the stakeholders' perceptions of the value created. Localism does also have darker sides and should, therefore, be pursued in a responsible way. To conclude, localism appears as a potential sustainability strategy that should be explored further by scholars, policymakers, and business practitioners.

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References

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Black, Sandy. 2008. *Eco-chic: The fashion paradox*. London: Black Dog.

Bocken, N. M. P., P. Rana, and S. W. Short. 2015. "Value mapping for sustainable business thinking." *Journal of Industrial and Production Engineering* 32 (1): 67–81.

Bocken, N. M. P., Samuel W. Short, Padmakshi Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Carroll, Archie B., and Ann K. Buchholtz. 2012. *Business & society: Ethics, sustainability, and stakeholder management*. Boston, MA: Cengage Learning.

Casadesus-Masanell, Ramon, and Joan Enric Ricart. 2010. "From strategy to business models and onto tactics." *Long Range Planning* 43 (2–3): 195–215.

Clinton, Lindsay, and Ryan Whisnant. 2014. Model behavior: 20 business model innovations for sustainability. Brooklyn, NY: SustainAbility.

Crane, Andrew, and Dirk Matten. 2016. *Business ethics: Managing corporate citizenship and sustainability in the age of globalization*. Oxford: Oxford University Press.

Darnall, Nicole, Irene Henriques, and Perry Sadorsky. 2010. "Adopting proactive environmental strategy: The influence of stakeholders and firm size." *Journal of Management Studies* 47 (6): 1072–94.

Desai, Pooran, and Sue Riddlestone. 2002. *Bioregional solutions for living on one planet*. Schumacher Briefings 8. London: Green books.

Dolfsma, Wilfred, and Rene Van der Eijk. 2016. "Distances in organizations: Innovation in an R&D lab." *British Journal of Management* 27 (2): 271–86.

Eder-Hansen, Jonas, Caroline Chalmer, Sofia Tärneberg, Thomas Tochtermann, Javier F. Seara, Sebastian Sebastian Boger, Gabrielle Theelen, Sebastian Schwarz, Lise Kristensen, and Kristina Jäger. 2017. *Pulse of the fashion industry*. Copenhagen: Global Fashion Agenda & The Boston Consulting Group.

Ellen MacArthur Foundation. 2017. *A new textiles economy: Redesigning fashion's future*.

Espeli, Harald. 1997. "Protectionism, lobbying and innovation: Perspectives on the development of the Norwegian textile industry, especially since 1940." *Scandinavian Economic History Review* 45 (3): 257–75.

Evans, Steve, Doroteya Vladimirova, Maria Holgado, Kirsten Van Fossen, Miying Yang, Elisabete A. Silva, and Claire Y. Barlow. 2017. "Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models." *Business Strategy and the Environment* 26 (5): 597–608.

Fletcher, Kate. 2013. *Sustainable fashion and textiles: Design journeys*. London and New York: Routledge.

Fratocchi, Luciano, Carmela Di Mauro, Paolo Barbieri, Guido Nassimbeni, and Andrea Zanoni. 2014. "When manufacturing moves back: Concepts and questions." *Journal of Purchasing and Supply Management* 20 (1): 54–59.

Gray, John. 2015. *False dawn: The delusions of global capitalism*. London: Granta Books.

Guthey, Greig Tor, Gail Whiteman, and Michael Elmes. 2014. "Place and sense of place: Implications for organizational studies of sustainability." *Journal of Management Inquiry* 23 (3): 254–65.

Hall, Anthony, and Harrie Vredenburg. 2003. "The challenge of sustainable development." *MIT Sloan Management Review* 45 (1): 61–68.

Hebrok, Marie, Ingun Grimstad Klepp, Tone Skårdal Tobiasson, Kirsi Laitala, Marit Vestvik, and Madeline Buck. 2012. "Valuing Norwegian Wool." National Institute for Consumer Research (SIFO). Professional report 5-2012.

Hess, David J. 2009. *Localist movements in a global economy: Sustainability, justice, and urban development in the United States*. Cambridge, MA: MIT Press.

Hines, Colin. 2013. *Localization: A global manifesto*. London: Routledge.

Horlings, Lummina G., and Terry K. Marsden. 2014. "Exploring the 'New Rural Paradigm' in Europe: Eco-economic strategies as a counterforce to the global competitiveness agenda." *European Urban and Regional Studies* 21 (1): 4–20.

International Council for Local Environmental Initiatives (ICLEI) and The International Development Research Centre (IDRC). 1996. *The Local Agenda 21 Planning Guide*. Toronto: The International Development Research Centre (IDRC).

Inigo, Edurne A., Laura Albareda, and Paavo Ritala. 2017. "Business model innovation for sustainability: Exploring evolutionary and radical approaches through dynamic capabilities." *Industry and Innovation* 24 (5): 515–42.

Jervell, Anne Moxnes, and Svein Ole Borgen. 2004. "New marketing channels for food quality products in Norway." *Food Economics-Acta Agriculturae Scandinavica, Section C* 1 (2): 108–18.

Kibler, Ewald, Matthias Fink, Richard Lang, and Pablo Muñoz. 2015. "Place attachment and social legitimacy: Revisiting the sustainable entrepreneurship journey." *Journal of Business Venturing Insights* 3: 24–29.

Kinkel, Steffen. 2012. "Trends in production relocation and backshoring activities: Changing patterns in the course of the global economic crisis." *International Journal of Operations & Production Management* 32 (6): 696–720.

Lozano, Rodrigo. 2018. "Sustainable business models: Providing a more holistic perspective." *Business Strategy and the Environment*. https://doi.org/10.1002/bse.2059.

Lüdeke-Freund, Florian, Lorenzo Massa, Nancy Bocken, Alan Brent, and Josephine Musango. 2016. "Business models for shared value." Cape Town: Network for Business Sustainability South Africa.

Magretta, Joan. 2002. "Why business models matter." *Harvard Business Review* 80 (5): 86–92.

Marsden, Terry, and Everard Smith. 2005. "Ecological entrepreneurship: Sustainable development in local communities through quality food production and local branding." *Geoforum* 36 (4): 440–51.

Maskell, Peter, and Anders Malmberg. 1999. "Localised learning and industrial competitiveness." *Cambridge Journal of Economics* 23 (2): 167–85.

Osterwalder, Alexander, and Yves Pigneur. 2010. *Business model generation: A handbook for visionaries, game changers, and challengers*. Hoboken, NJ: Wiley.

Porter, Michael E., and Mark R. Kramer. 2011. "The big idea: Creating shared value." *Harvard Business Review* 89 (1): 2.

Quinn, S. 2008. 'Environmental stewardship and sustainable sourcing.' In *Sustainable fashion: Why now*, edited by J. Hethorn & C. Ulasewicz, 358–84. New York: Fairchild Books.

Roome, Nigel, and Céline Louche. 2016. "Journeying toward business models for sustainability: A conceptual model found inside the black box of organisational transformation." *Organization & Environment* 29 (1): 11–35.

Seuring, Stefan, and Martin Müller. 2008. "From a literature review to a conceptual framework for sustainable supply chain management." *Journal of Cleaner Production* 16 (15): 1699–710.

Shrivastava, Paul, and James J. Kennelly. 2013. "Sustainability and place-based enterprise." *Organization & Environment* 26 (1): 83–101.

Stubbs, Wendy, and Chris Cocklin. 2008. "Conceptualizing a 'sustainability business model'." *Organization & Environment* 21 (2): 103–27.

Sundkvist, Åsa, Rebecka Milestad, and AnnMari Jansson. 2005. "On the importance of tightening feedback loops for sustainable development of food systems." *Food Policy* 30 (2): 224–39.

Szekely, Francisco, and Heidi Strebel. 2013. "Incremental, radical and game-changing: Strategic innovation for sustainability." *Corporate Governance* 13 (5): 467–81.

Teece, David J. 2010. "Business models, business strategy and innovation." *Long Range Planning* 43 (2–3): 172–94.

Thomas, David F., and Jennifer E. Cross. 2007. "Organizations as place builders." *Journal of Behavioral and Applied Management* 9 (1): 33.

Yin, Robert K. 2009. *Case study research and applications: Design and methods*. Los Angeles: Sage.

Zott, Christoph, and Raphael Amit. 2008. "The fit between product market strategy and business model: Implications for firm performance." *Strategic Management Journal* 29 (1): 1–26.

Zott, Christoph, Raphael Amit, and Lorenzo Massa. 2011. "The business model: Recent developments and future research." *Journal of Management* 37 (4): 1019–42.

12

Identifying Strategies for Sustainable Entrepreneurship

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Introduction

Entrepreneurial action has traditionally been embodied in people's relationships with the material and social environment, and entrepreneurship has always consisted of discovering an opportunity (Shane and Venkataraman 2000). Sustainable business and sustainable entrepreneurship are continuously growing areas in modern society. Over the

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last few decades, the deterioration of the environment and its consequences for humanity have led to new government policies and changes in the legislative framework for private sector activities and businesses (Kiron et al. 2013). Although knowledge related to green innovation and eco-innovation seems to be growing (Franceschini et al. 2016; Schiederig et al. 2012), some notable gaps exist in our current understanding. For example, new innovation strategies are needed to support sustainable entrepreneurship. Oke et al. (2012) observed that little attention has been paid to the conditions under which innovation strategy execution is likely to be effective in enhancing innovation performance and, consequently, firm financial performance. Further, there is a lack of understanding of how different innovation strategies contribute to sustainable entrepreneurship strategies. To develop a better understanding of sustainable entrepreneurship, this chapter provides insights into (1) the utilisation of different sustainable innovation strategies and (2) the valuation of environmental, economic, and social sustainability factors in different sustainable entrepreneurship strategies. We argue that if the content of sustainable entrepreneurship strategies can be more precisely recognised and understood, then entrepreneurs will be able to enhance their businesses by focusing on the factors (e.g. the reduction of energy consumption, costs, and waste) that enable these strategies.

This chapter contributes to this research gap by exploring the sustainable entrepreneurship strategies used among horse industry operators in Finland. Although the sustainable entrepreneurship strategies explored in this chapter are used in a single industry, we believe that the results are useful for other industry operators as well as academics. At the practical level, the context of the horse industry is not significantly different from that of other agriculture-related industries; therefore, we believe that the results can be utilised by different decision-makers, agricultural industry operators, horse industry operators, energy producers, and many other stakeholder groups. For example, political decision-makers can utilise the results by determining which factors they should concentrate on if they want to support certain sustainable entrepreneurship strategies. For academics, this chapter provides important and interesting insights into which sustainable innovation strategies and individual sustainability factors are emphasised in different sustainable entrepreneurship strategies.

Sustainable Entrepreneurship

Sustainable entrepreneurship is a research area combining innovation, entrepreneurship, and sustainability (Sarkar and Pansera 2017; Schaefer et al. 2015; Schaltegger and Wagner 2011; Schaltegger et al. 2016). The literature on the interplay between entrepreneurship and sustainable development has addressed concepts such as environmental, social, and sustainable entrepreneurship. Each type of entrepreneurship provides a perspective on entrepreneurship as a process in which a business creates value beyond profit (Schaefer et al. 2015). Environmental entrepreneurship is motivated by earning money through solutions that solve environmental problems, whereas social entrepreneurship deals with achieving societal goals and securing funding (Schaltegger and Wagner 2011).

Sustainable entrepreneurship differs from environmental and social entrepreneurship because sustainable entrepreneurship focuses on entrepreneurial activities for sustainable development in a more comprehensive way, such as creating offerings that address environmental, social, and economic aspects simultaneously (Schaltegger and Wagner 2011; Stubbs 2017). Sustainable entrepreneurship can also be defined from a process perspective, which refers to the recognition, development, and exploitation of entrepreneurial opportunities in the context of social and environmental problems (Belz and Binder 2017; Lumpkin et al. 2013).

Similarly, Schaltegger et al. (2016: 268) defined sustainable entrepreneurship as “a sustainability mission-driven process of solving environmental and social problems of unsustainability by means of the exploration and exploitation of market opportunities created with innovative business models.” Bocken et al. (2014) divided these possible business models into technological-, social-, and organisational-oriented models. However, Boons and Lüdeke-Freund (2013) concluded that in order to be sustainable, the value proposition must provide environmental, social, and economic value. Researchers have concluded that the process of sustainable entrepreneurship remains largely unexplored (Belz and Binder 2017; Lumpkin et al. 2013; Schaltegger et al. 2016), thus necessitating further research. In particular, the management perspective of sustainability transitions is needed to produce new methods for creating value through sustainability (Boons and Lüdeke-Freund 2013). Hence, despite the increasing amount of research on sustainable entrepreneurship (Sarkar and Pansera 2017; Schaefer et al. 2015; Schaltegger and Wagner 2011; Schaltegger et al. 2016), little is known about the innovation strategies that characterise the different ways of creating business potential through sustainable entrepreneurship.

Innovation Strategies

Over the past decade, societies and firms have become increasingly aware of the environmental, economic, and social pressures their activities face, and, particularly during the last five years, research on green innovation and its interplay with economic performance has expanded to increase the current understanding of the ways in which new services, technologies, and business models enable societies and individual organisations to become more sustainable (Boons and Lüdeke-Freund 2013; Boons et al. 2013; Rizos et al. 2016). In the long term, the sustainable development of firms requires the adoption of green innovations. Such innovations can be more effectively developed and adapted when they are built on business models (Boons et al. 2013) and successful innovation strategies. Ireland et al. (2009) found that firms need the right set of organisational factors that include strategy, resources, and skills to successfully exploit the entrepreneurial spirit and improve innovation performance. Thus, an innovation strategy adopted in response to changes in nature and society will strategise and deploy resources appropriately to improve firm sustainability (Oke et al. 2012). The adoption of innovation strategies may be related to the exploitation of new technologies or services, investment in new technologies, or participation in new business models. Innovation strategies related to utilisation and investment in technological innovations have been suggested as important solutions to several sustainability challenges, such as the utilisation of renewable energy and nutrient recycling (Long et al. 2016). Thus, technology-based innovation strategies can play an important role in achieving economic growth and sustainable development (Shrivastava et al. 2016).

The adoption of service innovations and service-related innovation strategies can be seen as an engine for the renewal and sustainable development of individual firms and whole industries and as a catalyst for economic growth (Snyder et al. 2016). The innovation strategies related to service innovations can be linked to product and process innovations (Snyder et al. 2016) that pay attention to customer's changing roles (Michel et al. 2008) and new business models (Hsieh et al. 2013).

Innovation strategies related to business model innovation can be seen to be an important part of the approach to sustainable business and improving firms' sustainability (Boons and Lüdeke-Freund 2013; Chesbrough 2010; Yang et al. 2017). Business model innovation strategies are not necessarily related to new technologies or services, but rather they are new ways of creating and delivering value to stakeholders (Yang et al. 2017). Moreover, while utilising innovation strategies related to new business models, a business model innovation itself can become the source of a competitive advantage that supports firms' sustainable development (Boons and Lüdeke-Freund 2013; Chesbrough 2010). Although the importance of the successful use of innovation strategies as part of the sustainable development of firms, industries, and societies has been recognised, little attention has been paid to innovation strategies for sustainable entrepreneurship. In summary, this chapter classifies sustainable innovation strategies in four groups: investment in new technologies, exploitation of new technologies, exploitation of services, and participation in a new business model.

Empirical Examination of Sustainable Entrepreneurship

Horse industry entrepreneurs have long struggled with profitability. Increased costs and environmental regulations have created challenges for entrepreneurs, and new strategies are needed to increase the profitability of their business. Many options could be integrated in the entrepreneurs' existing core businesses. For example, waste (horse manure) could be utilised as a material for soil improvement or as an input for energy production in biogas plants, or it could be sold as processed fertiliser. The utilisation options support renewable energy production targets and the objectives of the circular economy, such as nutrient recycling, hence providing various strategies for horse industry entrepreneurs to build a new business, create jobs, improve energy self-sufficiency, and reduce greenhouse gas emissions. This industry thus offers a fruitful setting to study innovation strategies for sustainable entrepreneurship.

Data Collection

The data for this research was gathered using an Internet-based survey questionnaire in August and early September of 2016. The population for this research comprises horse industry operators (cluster sampling, see Zikmund et al. 2013) in Finland. In designing the questionnaire, the extant literature was used to formulate the survey items (Delai and Takahashi 2011; Khan et al. 2016; Mamede and Gomes 2014; Svensson and Wagner 2015); thus, it may be considered tested and valid. The questionnaire consisted of 18 questions, of which three were related to the background information of the participants. Nine of the questions were related to the participants' current operations, two were related to the current risks and cost risks of the operators, one was related to the utilisation of sustainable innovation strategies (presented in Table 12.1), and one was related to the individual sustainability factors behind those innovation strategies (presented in Table 12.2); there were also two open questions regarding future of the horse industry. An invitation to

Table 12.1 Cluster analysis results

Innovation strategy	Mean				
	Overall ($n = 133$)	Cluster 1 ($n = 45$)	Cluster 2 ($n = 35$)	Cluster 3 ($n = 25$)	Cluster 4 ($n = 28$)
Exploitation of a new technology	5.04	6.76	4.43	6.24	2.14
Investment in a new technology	3.69	5.78	2.80	3.76	1.46
Exploitation of a new service	4.99	5.76	5.49	5.88	2.25
Participation in a new business	4.49	6.51	4.83	2.80	2.29

participate in the survey was e-mailed to 631 Finnish horse industry entrepreneurs. Of the e-mailed questionnaires, 580 reached the recipients, and 51 were returned to the researchers with return-to-sender messages, indicating that the informants' e-mail addresses were no longer valid. A week after the questionnaire was first e-mailed, the first round of reminders was sent, resulting in a response peak. A week after the first reminder, another round of reminders was sent. Two weeks later, the received data were screened. A total of 133 valid responses were received and analysed, representing a response rate of around 23%. Responses were considered invalid and were excluded from the analysis if any of the following criteria were met: if most of the answered items included missing values, if it was obvious that the responses were deliberately incorrect throughout the survey, and/or if there were inconsistencies in the responses.

Measurements

To understand sustainable innovation strategies for sustainable entrepreneurship, the analysis in this research is based on the respondents' willingness to use innovation strategies and the sustainability factors behind these strategies. In addition, three background variables (size, costs, and distance to a large industry operator) were entered in the questionnaire. The items related to sustainable innovation strategies and sustainability factors were constructed based on the current literature and research on innovation and sustainable development. The variables for sustainable innovation strategy (exploitation of a new technology, investment in a new technology, exploitation of a new service, and participation in a new business) were measured with one item each. These strategies were identified from the literature and modified into items by the authors. Each strategy variable was measured on a 7-point Likert scale, with response options ranging from "Not willing" to "Extremely willing" to utilise the sustainable innovation strategy.

Individual sustainability factors (presented in Table 12.2) were used to describe and validate the utilisation of the sustainable innovation strategies. Each variable was measured on a 7-point Likert scale, with response options ranging from "Not significant" to "Very significant." For motivational factors to utilise the innovation strategies, current industry-specific risks and cost risks (in this context, risks related to handling and utilisation of horse manure) were measured on the same 7-point Likert scale, with response options ranging from "Not significant" to "Very significant."

Cluster Analysis Results

To explore the various sustainable entrepreneurship strategies used, cluster analysis was employed to group the horse industry entrepreneurs into homogenous categories based on the entrepreneurs' exploitation of different sustainable innovation strategies (Table 12.1): exploitation of a new technology (Shrivastava et al. 2016), investment in a new technology (Long et al. 2016), exploitation of a new service (Snyder et al. 2016), and participation in a new business (Yang et al. 2017).

After the four clusters were identified, their characteristics (based on costs, firm size, and distance to large industry operators) were explored. In clusters 1 and 3, costs were larger than in the other two clusters. Small firms were mostly included in clusters 3 and 4, whereas medium-sized firms were in clusters 1 and 2. Most of the firms that were farther from large industry operators were in cluster 1, and the ones that were closer to large industry operators were in cluster 3.

Table 12.2 The means of the sustainability factors in each cluster

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Sig.	Null hypothesis
Risks	3.8000	2.6571	3.2917	1.7500	.000	Rejected
Cost risks	4.3721	3.1143	4.0400	1.7778	.000	Rejected
Waste and emission reduction	6.1818	5.1471	5.3913	5.3571	.015	Rejected
Improvement in hygiene	6.0000	5.0882	5.0435	4.9286	.007	Rejected
Reduction of energy consumption	6.6818	5.6667	6.0870	5.5000	.000	Rejected
Improvement in land use	6.3636	5.6667	5.1739	5.8571	.016	Rejected
Job creation	6.2955	5.5588	5.5652	4.9286	.001	Rejected
Health and safety improvement	6.2045	4.9118	5.6522	4.9643	.001	Rejected
Cost reduction	6.7500	6.4412	6.3043	5.4815	.000	Rejected
Increase in income	6.6136	6.2941	5.6957	5.4286	.000	Rejected
Creation of indirect jobs	6.1364	5.5000	5.4348	4.7500	.001	Rejected
Creation of new business	6.2955	5.4706	4.9130	4.8929	.000	Rejected

In addition, the individual sustainability factors that influenced the sustainable entrepreneurship strategies were explored. Ten individual sustainability factors and two motivational factors (risks and cost risks) were explored for each cluster. Table 12.2 presents the sustainability and motivational factors for each cluster, as well as a summary of the most valued sustainability factors for each cluster.

Generally, the clusters valued many of the same sustainability factors. For example, cost reduction, reduced energy consumption, and increased income were among the most valued sustainability factors in every cluster. Entrepreneurs in clusters 1 and 2 valued a variety of sustainability factors equally (particularly environmental and economic factors). Social sustainability factors were pronounced in cluster 3, among other environmental and economic sustainability factors. The most valued factors among entrepreneurs in cluster 4 were in the environmental sustainability category, but economic sustainability was also among the most valued sustainability factors.

Characteristics of the Clusters

Cluster 1: Trailblazers

This cluster consisted of 45 entrepreneurs and was the largest (33.8% of all entrepreneurs). As motivational factors, current risks, and cost risks were the most significant. The entrepreneurs' actual costs seem to be larger than average. This cluster includes more medium-sized firms than the other clusters, as well as firms far from other large industry operators. In response to the current challenges, these entrepreneurs seem to be extremely interested in possibilities for new business models to increase income and reduce energy consumption, which seem to them to have great potential for creating new businesses and indirect jobs. Their sustainable entrepreneurship strategy seems to be very comprehensive, and they seem willing to adopt best practices, no matter whether they are related to the exploitation of a new technology or investment, the exploitation of a new service, or participation in a new business. These entrepreneurs see innovations as possibilities for cost reduction, job creation, new business models, reduction of energy consumption, and improvement of land occupation. This cluster seems to be a group of entrepreneurs who face the most risk in their current operations but who also have the most comprehensive sustainable entrepreneurship strategy, and they want to adopt innovations to improve the economic, institutional, and environmental sustainability of their businesses.

Cluster 2: Ride Sharers

The sustainable entrepreneurship strategies of this cluster of 35 entrepreneurs do not have risks or cost as motivational factors. The entrepreneurs' costs are low, and the firms are small or medium sized. Because they do not have significant risks or cost risks as a driver for strategies, their willingness to invest in new technologies seems very low. However, they seem to recognise the unutilised potential of the current situation of their businesses, and, therefore, they are willing to use participation in new business as the main part of their sustainable entrepreneurship strategy. These entrepreneurs are interested in taking advantage of the current not utilised potential of their businesses if they can do so as part of other entrepreneurs' innovation activities. Because these entrepreneurs do not seem face risks in their current activities, the firms seem interested in economic and institutional sustainability factors.

Cluster 3: Cost Cutters

The sustainable entrepreneurship strategies of the 25 sustainable entrepreneurs in this group seem to be motivated by risks and cost risks. There were more small firms in this cluster. However, they are in close proximity to large industry operators, and thus, possibilities for cooperation with other operators exist. The difference between the entrepreneurs in this cluster and cluster 1 is their sustainable entrepreneurship strategy for handling current challenges and risks. Whereas the Trailblazers in cluster 1 seem to have a comprehensive sustainable entrepreneurship strategy to utilise best practices to create something new and ease the current situation, the entrepreneurs in this cluster seem uninterested in investing in new technologies or being part of a new business. Their motivation to utilise new innovations and innovation strategies seems to be cost cutting of the current risks.

Cluster 4: Risk Avoiders

This cluster consisted of 28 entrepreneurs who do not seem to have any risks or cost risks as a motivational driver for their sustainable entrepreneurship strategies. The firms were either small or large. The main difference between the entrepreneurs in this cluster and those in cluster 2 is related to the unutilised potential of the current businesses. Whereas the entrepreneurs in cluster 2 seem to be interested in better utilisation of the current businesses, the entrepreneurs in cluster 4 either do not recognise the unutilised potential of their businesses or otherwise are not interested in utilising it. Therefore, they seem uninterested in using innovation strategies. Instead, they seem to be interested in developing their existing situation, and for that reason, they found environmental sustainability factors to be the most important ones.

Concluding Remarks

This chapter identified four clusters that describe strategies for sustainable entrepreneurship. The scientific novelty of this research lies in the description of the strategies entrepreneurs follow when they operate sustainable businesses. Cluster analysis was applied to the selected sustainable innovation strategies, and after that, clusters were identified based on groups of variables: background variables (cost, firm size, and distance to large industry operators), motivational factors (perceived risks and cost risks), and sustainability factors (environmental, social, and economic).

Based on the distinct patterns within the clusters exhibited by these variables, the clusters were labelled as follows: (1) Trailblazers (solution-oriented innovators with a comprehensive sustainable entrepreneurship strategy), (2) Ride Sharers (business-oriented, positive-thinking developers), (3) Cost Cutters (problem-oriented operators with a cost-cutting innovation strategy), and (4) Risk Avoiders (environment-oriented current state stabilisers). By identifying these clusters, this chapter contributes to the growing stream research on the connection between sustainable innovation and sustainable entrepreneurship.

As presented earlier in this chapter, many sustainable innovation options could be integrated into horse industry entrepreneurs' existing core businesses. One of the most interesting current options supporting renewable energy and nutrient recycling is biogas production. In biogas production, waste (e.g. horse manure) is utilised as an input in a biogas plant, creating process outputs (biogas and digestate) that can be utilised as energy or materials for soil improvement. To use sustainable innovations related to biogas production (e.g. technologies or input delivery services), horse industry entrepreneurs may need to facilitate collaboration among their operations. This is because the required level of investment might be too great for one or two entrepreneurs, and biogas plants might need more of the process input (horse manure) than the amount produced by a few entrepreneurs' operations. The cluster analysis presented in this chapter indicates that Trailblazers could act as leaders by taking the financial responsibility for the investments, and Ride Sharers could act, for example, to deliver the process input. Within the horse industry, these two clusters of entrepreneurs seem to be the groups most likely to use sustainable innovations.

The following are some concluding remarks regarding this chapter's contributions to the existing knowledge. First, this chapter showed that cost savings are one of the main drivers when sustainability and innovation are exploited simultaneously. Cost reduction was among the most valued sustainability factor in each cluster in this research. In addition, an increase in income was perceived as important by all clusters. This supports the previous definitions of sustainable entrepreneurship in which sustainable entrepreneurs have been considered as actors who contribute to solving social and environmental problems through a successful for-profit business.

Second, environmental sustainability is often documented as an additional characteristic of sustainable development. We observed that environmental valuation guides a business only after no considerable risks are caused by the operation. This outcome is realised through the importance of the environment as part of the sustainable entrepreneurship strategies of entrepreneurs in cluster 4 (Risk Avoiders). In the sustainable entrepreneurship strategies of the operators in cluster 4, current risks are not a motivational factor for a sustainable entrepreneurship strategy. As the entrepreneurs seem to be satisfied with their current situation, their motivation for future development seems to be environmental sustainability factors (e.g. improvement of land). These remarks support the environmental entrepreneurship literature, which has shown that a business is motivated by earning money through solutions that solve environmental problems. In the sustainable entrepreneurship strategies of those in cluster 3 (Cost Cutters), the importance of environmental sustainability factors (e.g. improvement of land or waste and emission reduction) was not highlighted. In the sustainable entrepreneurship strategies of those in cluster 3, current risks and cost risks related to businesses were motivational factors, but the strategies were mainly influenced by economic factors.

Third, the greater importance of the utilisation of sustainable entrepreneurship strategies is related to the reduction of energy consumption. Our results confirm this proposition. This important aspect seemed to be highlighted in the strategies of those in clusters 1 (Trailblazers) and 3 (Cost Cutters). The willingness to reduce energy consumption among the entrepreneurs in cluster 1 seems to be related to economic and environmental factors, whereas the motivation of the entrepreneurs in cluster 3 seems to be economic. Thus, reducing energy consumption is a characteristic of a sustainable entrepreneurship strategy in general, rather than a specific feature of individual entrepreneurs. In other words, the possibility of minimising energy consumption assists entrepreneurs in delivering eco-friendly solutions and is perceived as a strategic issue. Another important reason for the utilisation of sustainable entrepreneurship strategies is the creation of new business and the development and adoption of business model innovations.

It is not possible or even necessary that all companies be Trailblazers with such a comprehensive sustainable entrepreneurship strategy. However, Trailblazers can be an example for companies that are willing to simultaneously reduce energy consumption and create new business. Environmental regulations motivate companies to move towards green innovations, and the governmental aspects of sustainable development include elements of pertinent legislation, policies enacted in a community, and political support for development. The chapter suggests that when preparing regulations, legislation, and policies, policymakers should become more familiar with Trailblazers and their possible followers. In this way, the conceptual and analytical discussion of operationalising sustainable development could be increased. Future research interest may be aimed towards understanding Trailblazers and potential Trailblazers in more depth in order to support and highlight the importance of environment and sustainable entrepreneurship in the field of innovation.

References

Belz, Frank Martin, and Julia Katharina Binder. 2017. "Sustainable entrepreneurship: A convergent process model." *Business Strategy and the Environment* 26 (1): 1–17.

Bocken, Nancy M. P., Samuel W. Short, Padmakshi Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Boons, Frank, Carlos Montalvo, Jaco Quist, and Marcus Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Chesbrough, Henry. 2010. "Business model innovation: Opportunities and barriers." *Long Range Planning* 43 (2–3): 354–63.

Delai, Ivete, and Sérgio Takahashi. 2011. "Sustainability measurement system: A reference model proposal." *Social Responsibility Journal* 7 (3): 438–71.

Franceschini, Simone, Lourenço GD Faria, and Roman Jurowetzki. 2016. "Unveiling scientific communities about sustainability and innovation: A bibliometric journey around sustainable terms." *Journal of Cleaner Production* 127: 72–83.

Hsieh, Jung-Kuei, Hung-Chang Chiu, Chih-Ping Wei, HsiuJu Rebecca Yen, and Yu-Chun Cheng. 2013. "A practical perspective on the classification of service innovations." *Journal of Services Marketing* 27 (5): 371–84.

Ireland, R. Duane, Jeffrey G. Covin, and Donald F. Kuratko. 2009. "Conceptualizing corporate entrepreneurship strategy." *Entrepreneurship Theory and Practice* 33 (1): 19–46.

Khan, Eijaz Ahmed, Mohammed Naim A. Dewan, and Md. Maruf Hossan Chowdhury. 2016. "Reflective or formative measurement model of sustainability factor? A three industry comparison." *Corporate Ownership and Control* 13 (2): 83–92.

Kiron, David, Nina Kruschwitz, Martin Reeves, and Eugene Goh. 2013. "The benefits of sustainability-driven innovation." *MIT Sloan Management Review* 54 (2): 69–73.

Long, Thomas B., Vincent Blok, and Ingrid Coninx. 2016. "Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: Evidence from the Netherlands, France, Switzerland and Italy." *Journal of Cleaner Production* 112: 9–21.

Lumpkin, G. T., Todd W. Moss, David M. Gras, Shoko Kato, and Alejandro S. Amezcua. 2013. "Entrepreneurial processes in social contexts: How are they different, if at all?" *Small Business Economics* 40 (3): 761–83.

Mamede, Pedro, and Carlos F. Gomes. 2014. "Corporate sustainability measurement in service organizations: A case study from Portugal." *Environmental Quality Management* 23 (3): 49–73.

Michel, Stefan, Stephen W. Brown, and Andrew S. Gallan. 2008. "Service-logic innovations: How to innovate customers, not products." *California Management Review* 50 (3): 49–65.

Oke, Adegoke, Fred O. Walumbwa, and Andrew Myers. 2012. "Innovation strategy, human resource policy, and firms' revenue growth: The roles of environmental uncertainty and innovation performance." *Decision Sciences* 43 (2): 273–302.

Rizos, Vasileios, Arno Behrens, Wytze Van Der Gaast, Erwin Hofman, Anastasia Ioannou, Terri Kafyeke, Alexandros Flamos et al. 2016. "Implementation of circular economy business models by small and medium-sized enterprises (SMEs): Barriers and enablers." *Sustainability* 8 (11): 1212.

Sarkar, Soumodip, and Mario Pansera. 2017. "Sustainability-driven innovation at the bottom: Insights from grassroots ecopreneurs." *Technological Forecasting and Social Change* 114: 327–38.

Schaefer, Katrin, Patricia Doyle Corner, and Kate Kearins. 2015. "Social, environmental and sustainable entrepreneurship research: What is needed for sustainability-as-flourishing?" *Organization & Environment* 28 (4): 394–413.

Schaltegger, Stefan, Florian Lüdeke-Freund, and Erik G. Hansen. 2016. "Business models for sustainability: A co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation." *Organization & Environment* 29 (3): 264–89.

Schaltegger, Stefan, and Marcus Wagner. 2011. "Sustainable entrepreneurship and sustainability innovation: Categories and interactions." *Business Strategy and the Environment* 20 (4): 222–37.

Schiederig, Tim, Frank Tietze, and Cornelius Herstatt. 2012. "Green innovation in technology and innovation management—An exploratory literature review." *R&d Management* 42 (2): 180–92.

Shane, Scott, and Sankaran Venkataraman. 2000. "The promise of entrepreneurships as a field of research." *The Academy of Management Review* 25 (1): 217–26.

Shrivastava, Paul, Silvester Ivanaj, and Vera Ivanaj. 2016. "Strategic technological innovation for sustainable development." *International Journal of Technology Management* 70 (1): 76–107.

Snyder, Hannah, Lars Witell, Anders Gustafsson, Paul Fombelle, and Per Kristensson. 2016. "Identifying categories of service innovation: A review and synthesis of the literature." *Journal of Business Research* 69 (7): 2401–8.

Stubbs, Wendy. 2017. "Sustainable entrepreneurship and B corps." *Business Strategy and the Environment* 26 (3): 331–44.

Svensson, Göran, and Beverly Wagner. 2015. "Implementing and managing economic, social and environmental efforts of business sustainability: Propositions for measurement and structural models." *Management of Environmental Quality: An International Journal* 26 (2): 195–213.

Yang, Miying, Stephen Evans, D. Vladimirova, and P. Rana. 2017. "Value uncaptured perspective for sustainable business model innovation." *Journal of Cleaner Production* 140: 1794–804.

Zikmund, William G., Barry J. Babin, Jon C. Carr, and Mitch Griffin. 2013. *Business research methods*. Mason, OH: Cengage Learning.

Part III

Measurement and Assessment of Sustainable Innovation

Call for More Effective Sustainability Goals and Measurement

For decades, scientists have been warning that human actions are putting the planet's future at risk. The effects of a sick planet can already be seen: from social, economic and climate stability to energy, food and water security—all increasingly suffering from environmental degradation and climate change.

In 2016, the interdependence between social, economic and environmental agendas was recognized at the highest levels through the defining of the new set of Sustainable Development Goals, which means a transition to an approach that decouples human and economic development from environmental degradation. The speed and scale of this transition is essential, and enterprises are key actors if the transition is to succeed.

For enterprises, transition will require effective sustainable development strategies for radical and systemic innovations. It is about developing new products, processes, services and technologies that enable the economic development and well-being of peoples and institutions while respecting the planet's natural resources and regenerative capacity.

However, innovations can only happen if companies set goals and measure their performance as seriously as has so far been done for economic performance. Robust monitoring and assessment planning and instruments that can tell where companies are with regard to their sustainability goals, where they should be headed and what their options are, are needed.

As the need for sustainability among various stakeholders of companies is growing, innovating for sustainability can be expected to grow in importance from the standpoints of organizational legitimacy, reputation and performance. Thus, companies that are forerunners in radical innovations for sustainability may have a competitive advantage. In time, all companies will be forced to turn their business models towards sustainability as that is the only way our planet can survive.

Liisa Rohweder, Dr. (Sustainable development), Secretary General, WWF Finland

13

Sustainable Innovation Measurement: Approaches and Challenges

Nuwan Gunarathne

Introduction

Many argue that innovation is becoming increasingly important for both long-term survival and growth in intensely competitive and uncertain environments (Gunday et al. 2011; Rennings 2000). In the light of increasing consumer awareness, tightening government regulations and growing stakeholder expectations in respect of sustainable development, management of innovation oriented to sustainability (or sustainable innovation) is becoming an important issue for both companies and policy makers (Adams et al. 2016; Doran and Ryan 2016).

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Sustainable innovation or the innovations that include environmental and societal dimensions alongside economic aspects (Adams et al. 2016) are a powerful tool for new firms to undermine the already established firms or for established players to strengthen their position in competitive markets (Doran and Ryan 2016). Through innovations, firms can find new markets or increase the market share in existing markets as technological developments and stiff global competition rapidly erode the value added to existing products and services (Gunday et al. 2011). On the other hand, policy makers can use regulations and other mechanisms to promote sustainable innovations and thereby reduce environmental problems, enhance social welfare and incentivize expenditure on research and development (Doran and Rayon 2016). Hence, sustainable innovation is a crucial tool to fulfil the responsibilities to the environment and society in the pursuit of sustainable development (Calik and Bardudeen 2016).

According to United Nations (UN) Sustainable Development Goal (SDG) No. 9, "build resilient infrastructure, promote sustainable industrialization and foster innovation", sustainable innovation is a key to the creation of more sustainable industries to increase resource-use efficiency and adoption of clean and environmentally sound technologies and industrial processes (UN 2018). However, to motivate investment in sustainable innovations, it is essential to assess their potential contribution to the achievement of SDGs. Concrete evidence-based impacts of sustainable innovation can spur further investment, policy-level support and stakeholder commitment. Sound theoretical and methodological approaches are therefore needed to monitor, measure, communicate and evaluate sustainable innovations in the achievement of sustainability goals. However, measuring sustainability performance is a complex process in the light of multitudinous expectations about the economic, social and environmental responsibilities (Bocken et al. 2014; Coccia 2009). However, measurement of sustainable innovation and their performance, and sustainability indicator frameworks globally remains at a rudimentary and fragmented level (Bocken et al. 2014; Krajnc and Glavič 2003; Spangenberg 2002). The purpose of this chapter is therefore to discuss the approaches to and challenges in the measurement of sustainable innovations and sustainable innovation performance.

The chapter also presents some practical solutions to overcome such challenges.

The rest of the chapter is organized as follows. Section "Sustainable Innovations" provides an overview of sustainable innovation since a sound understanding of the concept is essential when discussing its measurement aspects. Section "Measuring Sustainable Innovations" and "Sustainable Innovation Performance Indicators" presents the measurement and assessment of sustainable innovation while focusing specifically on performance measurement and indicators for sustainable innovations. Section "Sustainable Innovation Performance Measurement Challenges and Possible Solutions" critically discusses the challenges in the application of the measurement of sustainable innovations. It also deals with some possible practical strategies to overcome such challenges. The last section provides the conclusions and contributions of the chapter.

Sustainable Innovations

Understanding what constitutes sustainable innovation is essential for developing any system for its assessment or measurement. In the extant literature, two similar terms have been largely used interchangeably though their exact meaning is not the same. They are: eco-innovations (sometimes interchangeably referred to as green, ecological and environmental innovations) and sustainable innovations (sometimes referred to as sustainability-oriented innovations) (Adams et al. 2016; Rennings 2000). Eco-innovations primarily focus on the environmental sustainability pillar of sustainable development. On the other hand, sustainable innovations[1] include environmental innovations and additionally incorporate societal dimensions alongside environmental and economic aspects (Adams et al. 2016; Calik and Bardudeen 2016).

Irrespective of whether it is an eco-innovation or sustainable innovation, it is not a prerequisite for them to be motivated primarily by environmental or social improvements (Carrillo-Hermosilla et al. 2010). They could also be a by-product of an economic motivation to reduce

Table 13.1 The typology of sustainable innovation

Sustainable innovation targets	Institutions Organizations and marketing	Primarily non-technological change			
	Processes and products	Primarily technological change			
		Modification	Redesign	Alternatives	Creation
		Sustainable innovation mechanisms			

Source Adapted from OECD (2009)

costs or improve market share (Horbach et al. 2012; Organisation for Economic Co-operation and Development [OECD] 2009). Hence, these innovations can be "sustainably motivated innovations" or "sustainably beneficial normal innovations" (Carrillo-Hermosilla et al. 2010). Nonetheless, sustainable innovations contribute to the achievement of sustainable development through the generation and creation of ecological and social improvements (Rennings 2000).

There are various types of sustainable innovations with different attributes, determinants and contributions to business performance (Adams et al. 2016). The typology provided by OECD (2009) for eco-innovation can be extended to systematically understand the different types of sustainable innovations (see Table 13.1).

With this brief overview of sustainable innovations, the next chapter focuses on the measurement aspects.

Measuring Sustainable Innovations

As mentioned at the beginning of this chapter, the measurement of sustainable innovation is still underdeveloped. This section first draws from the literature on eco-innovations in directing the discussion. The study of Arundel and Kemp (2009) can be regarded as the most prominent one that discusses the measurement aspects of eco-innovations (Calik and Bardudeen 2016; Cheng and Shiu 2012). Measuring eco (sustainable)-innovation is important for two reasons. First, it helps to identify the expected environmental and social benefits. Second, it helps companies, countries or regions to gauge their ability to retain/gain competitiveness through eco (sustainable)-innovation (Arundel and Kemp 2009; Boons and Lüdeke-Freund 2013; Coccia 2009).

In extending the eco-innovation approach of Arundel and Kemp (2009) for incorporating sustainable innovations, there are three measurement aspects that can be identified at a macro-level: (a) *nature*, (b) *drivers and barriers* and (c) *effects of eco-innovation*. The nature of the sustainable innovation is the innovation target given in the OECD typology (see Table 13.1). Hence, it is the categorization of sustainable innovations into products, processes, organization, marketing and institutions. Alternatively, it can also focus on the mechanism through which innovation is introduced such as modification, redesign, alternative or creation. The second aspect of innovation measurement can focus on drivers such as regulation, demand from users, capturing new markets, cost reduction and image or barriers of eco-innovation such as technological, financial, labour force related, regulatory, consumer related, supplier related and managerial. The third aspect is the measurement of the effects of sustainable innovation. In line with the sustainable development notion, these impacts should be measured in terms of economic, environmental and social dimensions. In measuring these impacts of sustainable innovations, companies are interested in micro-effects whereas policy makers are interested in meso (sectors)- and macro-level impacts. Hence, there are no "comprehensive frameworks consisting of a limited number of selected indicators based on a standardized, transparent and methodologically sound basis" and "clearly defined policy targets in all … dimensions and on different levels of society (meta, macro, meso and micro levels)" (Spangenberg 2002: 296).

There are four categories of measures for eco-innovations (Acs and Audretsch 1993; Arundel and Kemp 2009): (a) *input measures* such as R&D expenditure and R&D staff, (b) *intermediate output measures* such as number of patents and number of scientific publications, (c) *direct output measures* such as number of innovations and sales of new products and (d) *indirect impact measures* such as changes in resource efficiency and productivity. Calik and Bardudeen (2016) suggest that these measures can be either measures of innovation capability or innovation performance. Innovation capability-oriented measures focus on inputs and processes while performance-oriented models focus on output and results. Similarly, Alegre et al. (2006) opine that innovation performance is a construct with two different dimensions: *efficacy* and *efficiency*. They define innovation efficacy as "the degree of success of an innovation" and innovation efficiency as "the effort carried out to achieve that degree of success" (Alegre et al. 2006: 334). Hence, innovation efficacy measures are related to the innovation output/performance while innovation efficiency measures are related to innovation input/performance measures. These categories of measures are important when discussing sustainable innovation performance indicators. This aspect is discussed in the next section of the chapter.

Sustainable Innovation Performance Indicators

As outlined in the previous section, *innovation performance*[2] is related to the innovation output/results or the degree of success of the innovation (Acs and Audretsch 1993; Alegre et al. 2006; Arundel and Kemp 2009; Calik and Bardudeen 2016). Accordingly, sustainable innovation performance is the output/results of sustainable innovations reflecting the degree of success of the innovation in achieving the expected economic, social and economic output/outcomes. As in the case of traditional performance measurement, it is necessary to measure sustainable innovation performance in terms of performance indicators also (Gunarathne and Peiris 2017).

The indicators for performance measurement of sustainable innovations can be of two types, according to the famous work of Kaplan and Norton's (1996) Balanced Scorecard approach. First, there are *the lagging (outcome) indicators* which enable management to monitor the achievement of company goals and objectives (Kaplan and Norton 1996; Langfield-Smith et al. 2012). Though these indicators provide information on results achieved, they are inadequate to assist managers to directly manage performance or provide guidance on how to navigate the future (Kaplan and Norton 1996). On the other hand, the second type of indicators, *leading (driving) indicators*, focused on the factors that drive results. Improvements in leading indicators should result in improvements in lagging indicators over time (Langfield-Smith et al. 2012). In the context of sustainable innovations, the input measures which Arundel and Kemp (2009) suggest can be regarded as leading indicators as they are related to driving sustainable innovations. The other measurement categories of Arundel and Kemp (2009), i.e., intermediate output measures, direct output measures and indirect impact measures, can be regarded as lagging indicators as they produce the results of sustainable innovation outcome at various levels. As Kaplan and Norton (1996) recommend, it is necessary to have a mixture of leading and lagging measures even for sustainable innovations as both are vital for motivating and measuring sustainable innovations.

Another aspect to consider in setting indicators is representativeness, which can be addressed through the use of core and supplemental indicators. These indicators help overcome the difficulty of having a standardized set of indicators for the measurement of sustainable innovations due to the multidimensionality of sustainability (Arundel and Kemp 2009; Gunarathne and Peiris 2017; Veleva and Ellenbecker 2001). As a solution to this issue, Veleva and Ellenbecker (2001) suggest using a set of core and supplemental indicators. *Core indicators* represent a set of indicators that can be used in any situation by any entity, and they measure common aspects such as profit, water use, energy use, and employee satisfaction and welfare. *Supplemental indicators* are openly set and vary between companies/facilities. The purpose of supplemental indicators is to introduce flexibility by addressing additional production-specific aspects (Veleva and Ellenbecker 2001). The purpose of core and supplemental indicators should be to reflect the wholeness of the system while displaying the interaction among its subsystems (Gunarathne and Peiris 2017; Krajnc and Glavič 2003). For any of the above categories of sustainability measurement aspects, i.e., input or output measures or leading and lagging measures, a set of core and supplemental indicators can be used.

The next section of the chapter discusses the challenges associated with the performance measurement of sustainable innovation and some possible solutions to overcome them.

Sustainable Innovation Performance Measurement Challenges and Possible Solutions

There are three aspects regarding the challenges to the measurement of sustainable innovation performance:

- Problems associated with the conventional measurement of the performance of innovations,
- Problems associated with the measurement of sustainability and
- Unresolved problems associated with the traditional performance measurement.

These challenges are discussed below. The first challenge is related to the conventional problems of measuring the performance of innovations. As Calik and Bardudeen (2016) suggest, measurement of even normal/standard innovation, let alone sustainable innovation, is difficult. Second are the challenges to the measurement of sustainability since what is meant by sustainability and how it can be achieved are uncertain (Adams et al. 2016). The third challenge is the still unresolved problems associated with the traditional performance measurement of any organization, system or product. Since these measurement challenges are integrated, it is difficult to isolate them for discussion. Therefore, this section discusses these challenges without specifically referring them to their source of origin. These measurement challenges have to do with the identification of what constitutes sustainable innovations, identification and quantification of performance indicators, problems associated with the determination of system boundary and suitable time periods for measurement and performance comparisons. The rest of this section provides a critical discussion of these challenges while suggesting some practical remedies.

One of the first challenges that impede the measurement process is to identify sustainable innovations. Similar to other innovations, sustainable innovations lack a standard definition (Kesidou and Demirel 2012; Boons and Lüdeke-Freund 2013). An accepted definition or a framework such as the OCED (2009) typology can be a useful reference point in this identification process. As discussed in section "Sustainable Innovations", according to the OECD (2009) typology, there are different types of sustainable innovations such as product, process, organization, marketing and institutions. While product and process innovations are more observable and easy to evaluate, measurement of the other types of sustainable innovations is difficult (Calik and Bardudeen 2016). On the other hand, sustainable business models are important in driving the corporate innovations for sustainability (Bocken et al. 2014; Boons and Lüdeke-Freund 2013). Hence, there is a need for a creative approach informed by these definitions or typologies.

Another challenge is to identify areas for the development of sustainable innovation performance indicators in the economic, environmental and social spheres. As Bocken et al. (2014) put it, "it is not always so clear how delivering social and environmental value might translate into profit and competitive advantage for the firm" (p. 44). Since sustainability is a multidimensional concept, its measurement should consider and integrate economic, social and environmental aspects (Pope et al. 2004). Due to the multitude of sustainability aspects relevant to organizations and for which organizations are accountable, the measurement aspect can become complex (Gunarathne and Peiris 2017; Keeble et al. 2003). The areas in which the economic performance should be measured can be identified fairly easily (Keeble et al. 2003). Areas of several environmental domains such as energy and carbon, water, waste and materials too can be easily identified. However, identifying areas of biodiversity can be quite challenging. Similarly, the measurement areas in the social dimension of sustainable innovation performance can be difficult to identify because of the unclear nature of what is social sustainability (Krajnc and Glavič 2003; von Geibler et al. 2006).

One solution would be to use some accepted frameworks or internationally recognized standards in defining the dimensions of sustainability. For instance, ISO 14000, the Global Reporting Initiative (GRI), the Global Compact and WBCSD Eco-Efficiency Metrics can inform the identification of sustainable innovation performance indicators (Calik and Bardudeen 2016; Keeble et al. 2003). On the other hand, Coccia (2009) suggests a technometric technique to measure the impact of technological innovations on geo-economic environment.

Another solution is to use concepts such as "*the environmental space concept*" which uses a combination of system-specific measures with their inter-linkages (see Spangenberg 2002). Though these standards/frameworks can be a useful point of reference, there should be manager participation to plant a sense of ownership in the measurement process. The outcome of this exercise is a standard set of *Key Performance Indicators* (KPIs) in the economic, social and environmental spheres. (See Table 13.2 for some examples). These selected indicators should reflect the business realities, values and culture of the organization. Another aspect can be the engagement of stakeholders involved in and affected by the sustainable innovations. However, there can be a conflict between the indicators suggested by internal and external stakeholders. Hence, it will be necessary to strike a balance that reflects the concerns of various stakeholders (Keeble et al. 2003). Once the areas for performance measurement are determined, it will be pertinent to identify the materiality of the sustainability-related issues. Again, frameworks such as GRI offer some guidelines to identify the sustainability-related materiality issues for an organization, which should then lead to the development of relevant KPIs.

Even if these areas are identified, another practical and theoretical challenge is the quantification of sustainable innovation performance in the chosen areas. Frameworks, standards and methodologies can help to standardize measurement and accounting in certain areas such as water, energy and carbon. For instance, for the calculation of carbon footprint ISO/TS 14067:2013 standard information is available. However, such widely accepted frameworks for measurement are not available for many of the other environmental areas and social dimensions such as employee morale, community and engagement due to the lack of available markets of exchange (Coccia 2009).

Another challenge is to devise a system for the measurement of sustainable innovations (Keeble et al. 2003). Sustainable innovation measurement can be done at establishment, firm, industry, country and regional levels. When the scope is broadened, there will be additional measurement challenges. Conversely, even if the system boundary is limited to a unit/department of an organization, there will be challenges. This is because sustainable innovation is a result of interaction

Table 13.2 Examples of KPIs for sustainable innovation performance

Dimension		
Economic	Social	Environmental
% of annual sales/profits from the new products (for the last three years)	Increase in income of employees from new products	Amount of energy saved from a new processes
% of R&D (innovation) projects on budget	The number of accidents reduced by introducing a new production process	Carbon tonnes reduced/increased by introducing new products
Amount of additional taxes paid to government on new products	The number of new suppliers engaged through the new products developed	Waste generation/savings from a new production processes
Annual sales growth of new products developed	The number of stakeholder contacts made	Amount of water consumption reduced through a new production system
% of cost savings from the adoption of new technologies/processes	Number of new employment opportunities (direct and indirect) created due to the new products introduced	% of hazardous waste recycled from the new recycling plant

among many units in an organization (Calik and Bardudeen 2016). Hence, the demarcation of sustainable innovation performance among the various entities is challenging. Related to this issue are the challenges arising from the transdisciplinary nature of sustainability (Hadorn et al. 2006; Schaltegger et al. 2013). This requires a joint definition of sustainable innovation performance in a cross-disciplinary context with the focus on real word connection (Schaltegger et al. 2013). Hence, a single team or department is not capable of identifying, measuring and reporting sustainable innovation performance. As Schaltegger et al. (2013) put it, "understanding transdisciplinarity requires, in addition to an interdisciplinary scientific exchange, the collaboration of science and extra-science partners with the ultimate aim to develop knowledge that is actionable and relevant in practice" (p. 223). The involvement of various external parties such as academics and practitioners can accumulate new knowledge and create openness to innovation (Richter 2013). However, in the assessment of sustainable innovation performance measurement process, this will inevitably invite additional complexity, cost and time. This necessitates an organization to have a right mix of accuracy and practicability in the process of measurement.

Another issue related to measuring the sustainable innovation performance lies with determining the time period. Since many of the financial, environmental and social impacts of sustainable innovations are felt over a period of time, it is necessary to account for a reasonable time period rather than only focusing on a short period (Gunarathne and Peiris 2017; Bocken et al. 2014). For instance, sustainable innovations such as hybrid cars were not viable when they were first introduced but may become so in the future due to the changes in the business environment (Bocken et al. 2014). Many scholars therefore emphasize the use of full life cycle analysis in this regard (Kemp and Pearson 2008). However, when the sustainability performance over a long time period is measured, many other economic, marketing and other factors come into play (Calik and Bardudeen 2016). Hence, the isolation of the impacts of sustainable innovation performance will continue to be a challenge. Also, another question is to decide whether the innovation impacts should be measured ex-post or ex-ante (see Coccia 2009 for more details). The above techniques should therefore be applied before

Table 13.3 Sustainable innovation performance measurement challenges and solutions

Challenge	Source/s of the problem	Solution/s
Identification of what constitutes sustainable innovations	Lack of a standard definition for sustainable innovations	Following an accepted definition/framework for sustainable innovation identification E.g., *OECD* (2009) *typology*
Identification of sustainable innovation performance indicators in economic, environmental, and social spheres	Multidimensionality of the concept of sustainability	Use some accepted frameworks or internationally recognized standards for defining the dimensions of sustainability E.g., *ISO 14000, the Global Reporting Initiative (GRI), the Global Compact and WBCSD Eco-Efficiency Metrics* *Technometric techniques for technological innovations or "the environmental space concept"* Stakeholder engagement for identification of material sustainability issues
Quantification of sustainable innovation performance indicators	Lack of widely accepted frameworks for measurement E.g., *Measurement of community engagement and biodiversity*	Develop in-house performance indicators and use them consistently over time to identify the relative changes

(continued)

Table 13.3 (continued)

Challenge	Source/s of the problem	Solution/s
Problems associated with the determination of system boundary measurement and performance comparisons	Difficulty in determining the system boundary for sustainable innovation performance. Transdisciplinary nature of sustainability	Use of a mutually agreed system boundary E.g., *Consideration of sustainability impacts only at department level* Maintaining a right mix of accuracy and practicability in the process of measurement
Determination of the suitable time period for measurement	Long-term nature of the impacts of sustainable innovations Problems in deciding ex-post or ex-ante	Use of a reasonable time period for performance measurement E.g., *Use three years rather than only focusing on one year in sustainable agriculture innovations* Use of time value of money techniques and apply them ex-ante and ex-post E.g., *Net Present Value (NPV) or Internal Rate of Return (IRR) in a full life cycle analysis*
Benchmarking of sustainable innovation performance	Differences in the industries, companies or even departments (system boundaries)	Develop a set of core and supplemental indicators E.g., *Use of core indicators for comparison and supplemental indicators to capture the differences*

and after the sustainable innovation investment to enable ex-ante and ex-post evaluations.

Comparing sustainable innovation performance against other innovations can be another challenge. As discussed in the previous section, due to the differences in the industries, companies or even departments (system boundaries), it is necessary to have a set of core and supplemental indicators (Veleva and Ellenbecker 2001). While a comparison among the entities is possible by using core indicators, they will not necessarily capture the differences in the systems. The supplemental indicators introduced as a solution to overcome this issue will make it difficult to make comparisons as they will be entity specific. Hence, in the comparison or assessment of sustainable innovation performance, it will be necessary to maintain a right balance between the system representation and comparability.

Table 13.3 provides for a summary of these challenges, their sources of origin and possible solutions.

Conclusions

Sustainable innovation measurement remains at a rudimentary stage. This chapter aimed to discuss the approaches, challenges and possible solution for the measurement of sustainable innovations and innovation performance. The challenges and issues rooted in the measurement of sustainability, innovations and traditional performance pose a number of challenges to sustainable innovation performance measurement.

The discussion provided in this chapter has several implications for practitioners and researchers. The lack of a common source of information acts as a deterrent for researchers and practitioners to get an overview of this field and it in turn "limits research, education and training in this subject area, and hence limits practical experimentation and implementation in industry" (Bocken et al. 2014: 44). For practitioners, it is pertinent to understand that sustainable innovation measurement process is a dynamic learning process that informs decision-making rather than an end in itself. Once a small set of KPIs are established and agreed on (some possible examples are presented in Table 13.2), a review process should be in place for continuous improvement. This would allow practitioners to develop a more robust set of indicators that accurately measure the sustainable innovation performance towards the expected objectives. Since the field is still developing and evolving, inter-industry and intra-industry benchmarking of measurement practices can also offer practical solutions. For researchers, sustainable innovation measurement offers wide opportunities for developing and testing theory. In parallel with the development of theory in this area, more research will be needed on the application of theory in the future, particularly on how to build a link between sustainable innovations and business models in research (Bocken et al. 2014; Boons and Lüdeke-Freund 2013). Also, it will be necessary to develop industry- and country-specific measurement indicators to reflect the differences in industries, regions and level of socio-economic development of countries.

Notes

1. *Sustainable innovations* are "any new or significant improvement of products, services, technological or organizational processes, commercialized or internally implemented that not only provide economic benefits but also generate positive social and environmental impacts" (Calik and Barbudeen 2016: 449).
2. According to the Oxford Dictionary (2018), *performance* is "a task or operation seen in terms of how successfully it is performed" or "the capabilities of a machine, product, or vehicle [or innovation]". Hence, the definition we choose for sustainable innovation performance is consistent with the traditional literal meaning of the term.

References

Acs, Zoltan J., and David B. Audretsch. 1993. "Analyzing innovation output indicators: The US experience". In *New concepts in innovation output measurement*, edited by Donald Bain and Alfred Kleinknecht, 10–41. London: Palgrave Macmillan.

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Alegre, Joaquín, Rafael Lapiedra, and Ricardo Chiva. 2006. "A measurement scale for product innovation performance." *European Journal of Innovation Management* 9 (4): 333–46.

Arundel, Anthony, and René Kemp. 2009. *Measuring eco-innovation.* Maastricht: UM-MERIT Research Memorandum.

Bocken, Nancy MP, Samuel W. Short, P. Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. *Journal of Cleaner Production* 45: 9–19.

Calik, E., and F. Bardudeen. 2016. "A measurement scale to evaluate sustainable innovation performance in manufacturing organizations." *Procedia CIRP* 40: 449–54.

Carrillo-Hermosilla, Javier, Pablo Del Río, and Totti Könnölä. 2010. "Diversity of eco-innovations: Reflections from selected case studies." *Journal of Cleaner Production* 18: 1073–83.

Cheng, Colin C., and Eric C. Shiu. 2012. "Validation of a proposed instrument for measuring eco-innovation: An implementation perspective." *Technovation* 32: 329–44.

Coccia, Mario. 2009. "Measuring the impact of sustainable technological innovation." *International Journal of Technology Intelligence and Planning* 5 (3): 276–88.

Doran, Justin, and Geraldine Ryan. 2016. "The importance of the diverse drivers and types of environmental innovation for firm performance." *Business Strategy and the Environment* 25 (2): 102–19.

Gunday, Gurhan, Gunduz Ulusoy, Kemal Kilic, and Lutfihak Alpkan. 2011. "Effects of innovation types on firm performance." *International Journal of Production Economics* 133 (2): 662–76.

Gunarathne, AD Nuwan, and H. M. P. Peiris. 2017. "Assessing the impact of eco-innovations through sustainability indicators: The case of the commercial tea plantation industry in Sri Lanka." *Asian Journal of Sustainability and Social Responsibility* 2 (1): 41–58.

Hadorn, Gertrude Hirsch, David Bradley, Christian Pohl, Stephan Rist, and Urs Wiesmann. 2006. "Implications of transdisciplinarity for sustainability research." *Ecological Economics* 60: 119–28.

Horbach, Jens, Christian Rammer, and Klaus Rennings. 2012. "Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull." *Ecological Economics* 78: 112–22.

Kaplan, Robert S., and David P. Norton. 1996. "Linking the balanced scorecard to strategy." *California Management Review* 39 (1): 53–79.

Keeble, Justin J., Sophie Topiol, and Simon Berkeley. 2003. "Using indicators to measure sustainability performance at a corporate and project level." *Journal of Business Ethics* 44 (2–3): 149–58.

Kemp, René, and Peter Pearson. 2008. "Final Report MEI Project about Measuring Eco innovation: Deliverable 15 of MEI Project (D15)," UM Merit, Maastricht, 10.

Kesidou, Effie, and Pelin Demirel. 2012. "On the drivers of eco-innovations: Empirical evidence from the UK." *Research Policy* 41 (5): 862–70.

Krajnc, Damjan, and Peter Glavič. 2003. "Indicators of sustainable production." *Clean Technologies and Environmental Policy* 5 (3–4): 279–88.

Langfield-Smith, Kim, Helen Thorne, and Ronald W. 2012. *Management accounting: Information for creating and managing value*. New South Wales: McGraw Hill.

Organisation for Economic Co-operation and Development (OECD). 2009. *Sustainable manufacturing and eco-innovation: Framework, practices and measurement*. Synthesis report. OECD.

Oxford. 2018. Accessed May 3, 2018. https://en.oxforddictionaries.com/definition/performance.

Pope, Jenny, David Annandale, and Angus Morrison-Saunders. 2004. "Conceptualising sustainability assessment." *Environmental Impact Assessment Review* 24 (6): 595–616.

Rennings, Klaus. 2000. "Redefining innovation—Eco-innovation research and the contribution from ecological economics." *Ecological Economics* 32 (2): 319–32.

Richter, Mario. 2013. "Business model innovation for sustainable energy: German utilities and renewable energy." *Energy Policy* 62: 1226–37.

Schaltegger, Stefan, Markus Beckmann, and Erik G. Hansen. 2013. "Transdisciplinarity in corporate sustainability: Mapping the field." *Business Strategy and the Environment* 22 (4): 219–29.

Spangenberg, Joachim H. 2002. "Environmental space and the prism of sustainability: Frameworks for indicators measuring sustainable development." *Ecological Indicators* 2 (3): 295–309.

United Nations (UN). 2018. "Sustainable Development Goals". Accessed April 8, 2018. https://www.un.org/sustainabledevelopment/sustainable-development-goals/.

Veleva, Vesela, and Michael Ellenbecker. 2001. "Indicators of sustainable production: Framework and methodology." *Journal of Cleaner Production* 9 (6): 519–49.

von Geibler, Justus, Christa Liedtke, Holger Wallbaum, and Stephan Schaller. 2006. "Accounting for the social dimension of sustainability: Experiences from the biotechnology industry." *Business Strategy and the Environment* 15 (5): 334–46.

14

Assessing the Impact of Sustainable Business Models: Challenges, Key Issues and Future Research Opportunities

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Introduction

In a globalised world in which small changes can easily cause immense positive or negative impacts, the creation and diffusion of sustainable business models (SBMs) is a timely topic of increasing interest (Boons

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et al. 2013; Maltz et al. 2016; OECD 2012; Schaltegger et al. 2016). The SBM itself, with its overall claim to improve the economic, social and environmental value creation, is also subject to innovation (Inigo et al. 2017; Yang et al. 2017). That is because improving sustainability implies change and innovation (Evans et al. 2017) not only through innovations in technologies, products or services (Girotra and Netessine 2013) but also by embedding social and environmental goals in the whole business model (Schaltegger et al. 2012).

In line with Evans et al. (2017), we argue that an impact assessment of the SBM is needed to explore the various ways that business model innovations can lead to improved economic, social and environmental performance. However, the impact assessment of SBMs is a subject matter which has not yet been fully clarified. In a recent publication on business model assessments, the authors stated that "*management approaches for the assessment and management of business models and their innovation as a means of corporate sustainable development are currently not available*" (Lüdeke-Freund et al. 2017: 170–71). In addition, Boons and Bocken (2017: 46) argued that ecological impact assessments of the SBM have fallen short when a consideration of "*business models as entities in themselves, with scant attention given to the context in which they occur*" is made. In addition, Evans et al. (2017: 604) stated that "*many metrics are still under development (e.g., local water stress) or not well understood (e.g., wellbeing, biodiversity).*"

In the course of this discussion, this book chapter has been written to contribute to this debate by presenting a detailed set of propositions regarding impact assessment on the corporate business model level, which can guide future research. This approach has been chosen as, thus far, the results obtained by research have been ambiguous, and the discussion about the impact assessment of SBMs is fragmented. Thereby, the book chapter undertakes a synthesis of insights into SBM research and sustainability impact assessment. Four normative propositions are made to clarify the ongoing debates about the impacts of SBMs and form a basis to guide future research. The research question that directs

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this line of reasoning is "*whether the impact of a sustainable business model is measurable at all?*" Subsequently, this leads to two additional questions. First, what is the object of such an analysis and assessment? Second, how applicable are the sustainability assessment methods that already exist for SBM assessment? In this context, the challenges and key issues are identified which could also serve as a basis for the development of a *business model assessment method* in the future. We close the chapter with concluding remarks and provide an outlook for future research.

Sustainable Business Models and Their Impact Assessment

Sustainable Business Models

In general, a business model describes "*the design or architecture of the value creation, delivery, and capture mechanisms*" employed (Teece 2010: 172). A sustainable business model is helpful in "*describing, analysing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries*" (Schaltegger et al. 2016: 6). However, many more conceptual definitions and concepts nurtured from varying perspectives exist (e.g. Bocken et al. 2014; Schaltegger et al. 2016; Upward and Jones 2016; Jonker 2016), and the research on SBMs is fragmented (Lüdeke-Freund and Dembek 2017). The most pressing question seems to be whether such SBMs effectively contribute to sustainable development (SD) (Lüdeke-Freund et al. 2017) by guaranteeing social and environmental benefits and economic profits at the same time (Schaltegger et al. 2016). We argue that any discussion about the impact of (S)BMs must begin by clarifying the concept itself. In terms of impact assessment, this clarification requires understanding business models (BMs) as activities (e.g. Arend 2013; Zott and Amit 2010; Chesbrough 2010; Ritter and Lettl 2017; Inigo et al. 2017) that are grouped around essential elements (e.g. Osterwalder and Pigneur

2010), such as networks of partners or segments of customers. To subsume elements and components of BMs, varying numbers of building blocks are used (Osterwalder et al. 2005). Placing a central focus on (corporate) activities is crucial, as this examination is "*helpful to a broader debate concerning the uptake of tools that can move us away from unsustainability*" (Bebbington et al. 2007: 225). In addition to describing and determining activities and elements (see also Proposition 3), the different notions of sustainable value being created need to be explicitly defined to measure any positive, neutral or negative impacts (see also Proposition 4). Hence, the first proposition is formulated as follows:

Proposition 1 *A conceptual clarification of the SBM—including a depiction of the respective value created, delivered and captured—is needed prior to the impact assessment.*

Many definitions, tools and instruments have been developed to measure sustainability (Bond et al. 2012; Pope et al. 2017). Decision-makers need a sustainability measurement that they can use to support the choices they make regarding the most sustainable actions (Ness et al. 2007) in fields such as environmental, economic, social or technological improvement (Singh et al. 2012). This decision-making is only possible if they have appropriate models, metrics and tools available "*for articulating the extent to which, and the ways in which, current activities are unsustainable*" (Bebbington et al. 2007: 224). Sustainability impact assessment explores "*the economic, environmental and social impacts of a range of proposed policies, programmes, strategies and action plans*" (OECD 2010: 4) which makes it "*crucial to specify the relevant sustainability principles, objectives and criteria as fully and credibly as possible*" (Gibson 2001: 20). However, such an assessment of sustainability performance needs to consider impacts from a broader, hence systemic perspective, beyond the boundaries of corporations (Baumgartner and Rauter 2017; Searcy 2016; Schaltegger et al. 2016) by addressing all stakeholder demands (Pope et al. 2004) and reflecting the Triple Bottom Line (TBL) model of sustainability (Gibson 2001) from a long-term perspective (Ness et al. 2007). Taking this into account in the specific context of the impact assessment of SBMs, we identified the following challenges: first, an assessment method which can be used to consider value creation in a TBL sense is lacking; second, the assessment becomes even more complex if a variety of stakeholders is considered (Evans et al. 2017); and, third, the impact assessment on a BM level is impossible if the BMs are defined and understood as conceptual tools while ignoring relevant activities (e.g. Baden-Fuller and Morgan 2010; Hedman and Kalling 2003; Lüdeke-Freund et al. 2017; Schweizer 2005; Zott et al. 2011; Inigo et al. 2017). Hence, we expand Proposition 1 in the following way:

Proposition 2 *A conceptual clarification of the SBM at hand—including a depiction of the respective broader systemic sustainability value created, delivered and captured—is needed prior to the actual impact assessment by assigning relevant activities to every building block of a SBM.*

Exemplary Methods for Impact Assessment

One could consider the sustainability assessment methods that already exist (Bond et al. 2012; Moldavska and Welo 2015) and which focus on an identification of unsustainable corporate activities (Bebbington et al. 2007), such that activities cause positive and/or negative consequences (Rodríguez-Olalla and Avilés-Palacios 2017). In the absence of a SBM assessment method, we argue that existing sustainability assessment methods such as the Life Cycle Assessment (LCA) or checklists are useful tools (Beske-Janssen et al. 2015; Böhringer and Jochem 2007; Singh et al. 2012). To demonstrate the use and application of such methods and how they can be contextualised with SBM assessment, we provide examples in Table 14.1. While Table 14.1 does not offer an exhaustive list of possibilities, it can be used as a road map and guide to the diverse field of assessing impact (Pope et al. 2017: 213). First, given the importance and widespread nature of the diffusion, the Business Model Canvas (Osterwalder and Pigneur 2010) was chosen as a boundary object for our inventory. Second, examples of existing sustainability assessment methods (e.g. Schaltegger et al. 2002; Choi et al. 2003) were chosen to exemplify how they could be applied to measure the impact of the different activities assigned to each building block. We examined the purpose and applicability of these methods by incorporating the following criteria:

Table 14.1 Evaluation of assessment methods to weigh corporate activities related to business model building blocks (Author's illustration)

			Triple Bottom Line			Time dimension		Assessment rationale	
Building Blocks of the Business Model Canvas	Assessment Method	Focus area	People	Planet	Profit	Short-term	Long-term	Qualitative	Quantitative
	Which assessment method is chosen?	Which level does the relevant assessment method consider?	Does the relevant assessment method consider social aspects?	Does the relevant assessment method consider environmental aspects?	Does the relevant assessment method consider financial aspects?	Does the relevant assessment method consider (rather) short-term impacts?	Does the relevant assessment method consider (rather) long-term impacts?	Does the relevant assessment method focus on qualitative data?	Does the relevant assessment method focus on quantitative data?
Value proposition	LCA (ISO 2006a, b)	☑ product/service ☐ company ☐ system	–	√	–	√	√	–	√
	MIPS (Schmidt-Bleek 1994)	☑ product/service ☐ company ☐ system	–	√	–	–	–	–	√
	ISO 9001 (ISO 2015a, b)	☐ product/service ☑ company ☐ system	√	√	–	√	√	√	√
	TQ(E)M (e.g., Garza-Reyes et al. 2018)	☐ product/service ☑ company ☐ system	√	√	√	√	√	√	√
Customer relationships	Indicators (e.g., Yildirim 2017)	☑ product/service ☑ company ☑ system	√	√	√	√	(√)	–	√
	Checklist (e.g., Keramati et al. 2010)	☑ product/service ☑ company ☑ system	√	√	√	√	(√)	√	–

Note LCA = Life Cycle Assessment; MIPS = Material Input Per Service; TQ(E)M = Total Quality (Environmental) Management. – = not applicable; (√) = partly applicable; √ = applicable

1. Focus area of assessment: product/service, company, system (e.g. Ness et al. 2007; Robèrt et al. 2002);
2. Integration of nature-society systems (Ness et al. 2007) based on the Triple Bottom Line (Elkington 1998; Maltz et al. 2016);
3. Time dimension (short-term, long- and longer-terms interactions) (e.g. Hardi and Zdan 1997; Kates 2011; Lozano 2008).
4. Assessment rationale of analysis (qualitative, quantitative, a mixture of both) (e.g. Groesser and Jovy 2016; Lee 2006; Wood and Garnett 2010).

To exemplify the following Proposition 3, we provide examples of sustainability assessment methods for the building blocks "value proposition" and "customer relationships." They serve as suitable samples to illustrate potential challenges and are influential with regard to the overall business model impact since the core aspect of the value proposition is a product and/or service offered, and customer relationships are formed by the value proposition. Hence, the strategic decision concerning the design of the value proposition is central, also with regard to impacts on nature and society (Baumgartner and Rauter 2017). Moreover, while the value proposition can be described rather easily, customer relationships are, however, much fuzzier and less concrete than a product or a service. With regard to the sustainability assessment of customer relationships, specific methods are clearly lacking.

For the assessment of the impacts of the "value proposition," two product/service-oriented assessment methods were chosen. An LCA can be used to analyse the impacts of products and services (ISO 2006a, b) but is not a comprehensive analysis with regard to the TBL and "*falls short of analysis of the added value of business models*" (Scheepens et al. 2016: 257). Furthermore, the information demand of an LCA may challenge its application for the assessment of a value proposition, especially given the considerable time interval between the formulation and realisation of a BM. The MIPS concept is a measure of material flows over a product's entire lifetime. Two company-related sustainability assessment methods were chosen for quality management. The ISO 9001 standard, one of the most important guidelines (Castka and Balzarova 2008), includes a holistic certification system for continuous improvements of companies (Molina-Azorín et al. 2009; ISO 2015a, b).

Another method chosen was the more comprehensive Total Quality (Environmental) Management (TQ(E)M). "*TQM refers to a basic vision of what an organisation should look like and how it should be managed*" (Lewis et al. 2006: 540). For the assessment on a (S)BM level, it is suitable as it includes a wider stakeholder perspective and integrates the customer orientation, also regarding an environmental and social perspective (Pun 2002; van Schalkwyk 1998; Garza-Reyes et al. 2018). For "customer relationships," two methods that are applicable for a system-oriented assessment were chosen: first, indicators as simple and quantitative measures (e.g. Ness et al. 2007; Keramati and Shapouri 2016; Yildirim 2017); second, checklists as common and mainly qualitative assessment tools, for example, those used with respect to eco-design (Choi et al. 2003) to develop sustainable products (e.g. Schöggl et al. 2017), although they are used in relation to customers as well (e.g. Keramati et al. 2010; Uncles et al. 2003). For the assessment on a (S)BM level, such methods are suitable as they are flexible in their application with regard to contents or level of details, whereas they can be linked to existing standards, such as the Global Reporting Initiative (GRI 2016) or the ISO 9001 (ISO 2015a, b), to correspond with existing frameworks.

All together, we checked the proposed methods for their applicability regarding the criteria: focus area, TBL, time dimension and assessment rationale. The results indicate that despite some limitations, the methods, in general, are applicable and would suit as starting points for the SBM assessment. Based on this exemplification, the next proposition is formulated as follows:

Proposition 3 *Existing sustainability assessment methods could serve as starting points for measuring the impact of a SBM.*

System Boundaries and Sustainability Performance

We showed in Table 14.1 that several assessment methods exist that can be applied for the impact assessment of a SBM. In general, building blocks, like customer segments, mirror essential parts of a firm's value creation process, however, these building blocks offer more a categorisation than a description of an actual activity.

First, from an impact assessment perspective, the constellation of activities dedicated to value creation, delivery and capture is a central topic because it influences the result. Lüdeke-Freund et al. (2017) approached this issue by extracting five generic points of BM logic (production, marketing, capabilities and resources, financial, contextual) and refer them to the five different perspectives of a Sustainability Balanced Scorecard, which is an advantageous approach that can be taken towards performance measurement.

Second, the impact of a BM, whether it is sustainable by definition or not, can only be fully assessed by considering all essential activities from the raw material acquisition to the final disposal (life cycle perspective), which goes beyond organisational boundaries (e.g. Boons 2013; Hallstedt et al. 2015; ISO 2006a; Schaltegger et al. 2016). Hence, as with any method taken for sustainability assessment, the question of where to draw the system boundaries arises (Pryshlakivsky and Searcy 2013; ISO 2006a; Boons and Bocken 2017). This system boundary is not only determined by the process perspective (e.g. the product life cycle) but could also be influenced by the factors already mentioned, namely the focus area, the time span or the assessment rationale.

Third, many assessment methods, however, focus on short-term perspectives rather than consider a systematic, long-term view that reflects the basic principles of SD. This means that the usage of such methods mainly prioritises first-order sustainability performance ("efficiency") over second-order sustainability performance ("systemic effectiveness"). Such a prioritisation also neglects normative requests to embrace the multiple dimensions of a sustainability value proposition or include different stakeholder interests, as argued above. Moreover, it excludes the reflection of whether things are being done correctly or not (Baumgartner and Rauter 2017). These considerations lead to the next proposition, which is formulated as follows:

Proposition 4 *The impact assessment of SBMs needs to (1) focus on all activities and processes related to the SBM; (2) consider a life cycle perspective that integrates all sustainability dimensions, and (3) reflect on both first- and second-order sustainability performances.*

Summary and Conclusion

A sustainable business model serves as depiction of a company's activities regarding value creation, delivery and capture. As such, a SBM integrates sustainability by improving the economic, social and ecological performance of the respective organisation. Such an improvement implies that change in any of the elements of a SBM occur or leads to the creation of a completely new business model (Chesbrough 2010; Foss and Saebi 2017). In this context, the definition of the (sustainable) value proposition offered by the company is central, since the company determines the value delivered to customers and other primary and secondary stakeholders through the decisions made about its products and services (Schaltegger et al. 2012; Boons et al. 2013). This determination of a sustainable value proposition and its innovation would ideally be linked to the SBM impact measurement, meeting the requirement of not only being new—as compared to the status quo and a relevant reference—but also leading to environmental and/or social benefits (Boons et al. 2013; Breuer and Lüdeke-Freund 2017). While the impact assessment of SBMs is challenging both for scientists and practitioners, its successful application is highly relevant and needed. In the light of this, we have described four detailed propositions and provided examples in which we link the field of sustainability assessment to SBMs (see Table 14.1). The four propositions highlight the requirements for and potentials of such SBM impact assessments from a theoretical point of view. Practically, in the end, such SBMs would cause fewer negative impacts or even positive impacts compared to existing SBMs.

To make decisions about designing and implementing such SBMs, decision-makers need to be informed and provided with relevant tools. In the absence of "*a clear measurement system for the (…) value creation potential of SBMs*" (Evans et al. 2017: 604), existing sustainability assessment tools (Table 14.1) could serve as starting points of high practical relevance. This representation also highlights the need to measure economic, social and economic performance. Although the results of our research have natural limitations, they can serve as a foundation for future research by linking the debate of SBMs, its impacts and innovations to findings reported in the sustainability assessment literature.

Despite the fact that it is not possible at this time to provide a clear and final answer to the question of whether the impact of a SBM is measurable, an approach to do so has been developed. While normative requirements and practical attempts exist, the aim of such an assessment, including the definition of system boundaries and perspectives, must be further clarified and is greatly needed. In this respect, the existing sustainability assessment literature can be helpful.

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References

Arend, Richard J. 2013. "The business model: Present and future—Beyond a skeumorph." *Strategic Organization* 11 (4): 390–402.

Baden-Fuller, Charles, and Mary S. Morgan. 2010. "Business models as models." *Long Range Planning* 43 (2–3): 156–71.

Baumgartner, Rupert J., and Romana Rauter. 2017. "Strategic perspectives of corporate sustainability management to develop a sustainable organization." *Journal of Cleaner Production* 140: 81–92.

Bebbington, Jan, Judy Brown, and Bob Frame. 2007. "Accounting technologies and sustainability assessment models." *Ecological Economics* 61 (2–3): 224–36.

Beske-Janssen, Philip, Matthew Phillip Johnson, and Stefan Schaltegger. 2015. "20 years of performance measurement in sustainable supply chain management—What has been achieved?" *Supply Chain Management: An International Journal* 20 (6): 664–80.

Bocken, N. M. P., S. W. Short, P. Rana, and S. Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Bond, Alan, Angus Morrison-Saunders, and Jenny Pope. 2012. "Sustainability assessment: The state of the art." *Impact Assessment and Project Appraisal* 30 (1): 53–62.

Boons, Frank. 2013. "Organizing within dynamic ecosystems." *Organization & Environment* 26 (3): 281–97.

Boons, Frank, Carlos Montalvo, Jaco Quist, and Marcus Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production* 45: 1–8.

Boons, Frank, and Nancy Bocken. 2017. "Assessing the sharing economy: Analyzing ecologies of business models." In *Product lifetimes and the environment 2017—Conference proceedings*, edited by C. Bakker and R. Mugge, 46–50. Delft University of Technology: IOS Press.

Böhringer, Christoph, and Patrick E. P. Jochem. 2007. "Measuring the immeasurable—A survey of sustainability indices." *Ecological Economics* 63 (1): 1–8.

Breuer, Henning, and Florian Lüdeke-Freund. 2017. "Values-based network and business model innovation." *International Journal of Innovation Management* 21 (3). World Scientific Publishing Company: 1750028.

Castka, Pavel, and Michaela A. Balzarova. 2008. "The impact of ISO 9000 and ISO 14000 on standardisation of social responsibility—An inside perspective." *International Journal of Production Economics* 113 (1): 74–87.

Chesbrough, Henry. 2010. "Business model innovation: Opportunities and barriers." *Long Range Planning* 43 (2–3): 354–63.

Choi, Jun-Ki, Julie Ann Stuart, Karthik Ramani, and International Society for Environmental Information Sciences. 2003. "Decision support tools for environmental product and process management: Survey and needs." *Environmental Informatics Archives* 1: 24–37.

Elkington, J. 1998. "Partnerships from cannibals with forks: The triple bottom line of 21st century business." *Environmental Quality Management* 8 (1): 37–51.

Evans, Steve, Doroteya Vladimirova, Maria Holgado, Kirsten Van Fossen, Miying Yang, Elisabete A. Silva, and Claire Y. Barlow. 2017. "Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models." *Business Strategy and the Environment* 26 (5): 597–608.

Foss, Nicolai J., and Tina Saebi. 2017. "Business models and business model innovation: Between wicked and paradigmatic problems." *Long Range Planning* 51 (1): 9–21.

Garza-Reyes, Jose Arturo, Mingyang Yu, Vikas Kumar, and Arvind Upadhyay. 2018. "Total quality environmental management: Adoption status in the Chinese manufacturing sector." *The TQM Journal* 30 (1): 2–19.

Gibson, Robert B. 2001. *Specification of sustainability-based environmental assessment decision criteria and implications for determining "significance" in environmental assessment*. Canadian Environmental Assessment Agency.

Girotra, Karan, and Serguei Netessine. 2013. "Business model innovation for sustainability." *SSRN Electronic Journal*.

GRI—Global Reporting Initiative 2016. "GRI 101: Foundation." Amsterdam: Global Reporting Initiative. Accessed June 11, 2018. https://www.globalreporting.org/standards/gri-standards-download-center/gri-101-foundation.

Groesser, Stefan N., and Niklas Jovy. 2016. "Business model analysis using computational modeling: A strategy tool for exploration and decision-making." *Journal of Management Control* 27 (1): 61–88.

Hallstedt, Sophie I., Marco Bertoni, and Ola Isaksson. 2015. "Assessing sustainability and value of manufacturing processes: A case in the aerospace industry." *Journal of Cleaner Production* 108: 169–82.

Hardi, Peter, and Terrence Zdan. 1997. *Assessing sustainable development: Principles in practice*. *Canadian Cataloguing in Publication Data*. Winnipeg, Manitoba/Canada.

Hedman, Jonas, and Thomas Kalling. 2003. "The business model concept: Theoretical underpinnings and empirical illustrations." *European Journal of Information Systems* 12 (1): 49–59.

Inigo, Edurne A., Laura Albareda, and Paavo Ritala. 2017. "Business model innovation for sustainability: Exploring evolutionary and radical approaches through dynamic capabilities." *Industry and Innovation* 24 (5): 515–42.

International Organization for Standardization (ISO). 2006a. "ISO 14040:2006, Environmental management—Life cycle assessment—Principles and framework." Geneve.

International Organization for Standardization (ISO). 2006b. "ISO 14044:2006, Environmental management—Life cycle assessment—Requirements and guidelines." Geneve.

International Organization for Standardization (ISO). 2015a. "ISO 9000:2015, Quality management systems—Fundamentals and vocabulary." Geneve.

International Organization for Standardization (ISO). 2015b. "ISO 9000:2015, Quality management systems—Requirements." Geneve.

Jonker, Jan (ed.). 2016. *New business models. Working together on value creation*. Doetinchem, the Netherlands: Stichting OCF 2.0 Foundation.

Kates, R. W. 2011. "What kind of a science is sustainability science?" *Proceedings of the National Academy of Sciences* 108 (49): 19449–50.

Keramati, Abbas, and Fatemeh Shapouri. 2016. "Multidimensional appraisal of customer relationship management: Integrating balanced scorecard and multi criteria decision making approaches." *Information Systems and E-Business Management* 14 (2): 217–51.

Keramati, Abbas, Salman Nazari Shirkouhi, H. Moshki, and E. Maleki Berneti. 2010. "A hierarchical structure to evaluate risk of customer relationship management (CRM) projects." *International Journal of Electronic Customer Relationship Management* 4 (2): 97–124.

Lee, Norman. 2006. "Bridging the gap between theory and practice in integrated assessment." *Environmental Impact Assessment Review* 26 (1): 57–78.

Lewis, W. G., K. F. Pun, and T. R. M. Lalla. 2006. "Exploring soft versus hard factors for TQM implementation in small and medium-sized enterprises." *International Journal of Productivity and Performance Management* 55 (7): 539–54.

Lozano, Rodrigo. 2008. "Envisioning sustainability three-dimensionally." *Journal of Cleaner Production* 16: 1838–46.

Lüdeke-Freund, Florian, and Krzysztof Dembek. 2017. "Sustainable business model research and practice: Emerging field or passing fancy?" *Journal of Cleaner Production* 168: 1668–78.

Lüdeke-Freund, Florian, B. Freudenreich, I. Saviuc, S. Schaltegger, and M. Stock. 2017. "Sustainability-oriented business model assessment—A conceptual foundation." In *Analytics, innovation, and excellence-driven enterprise sustainability, palgrave studies in democracy, innovation, and entrepreneurship for growth*, edited by E. G. Carayanis and S. Sindakis, 169–206. Houndmills: Palgrave Macmillan.

Maltz, Elliot, Henry H. Bi, and Mark Bateman. 2016. "Benchmarking sustainability performance: The next step in building sustainable business models." *Journal of Public Affairs*. https://doi.org/10.1002/pa.1606.

Moldavska, Anastasiia, and Torgeir Welo. 2015. "On the applicability of sustainability assessment tools in manufacturing." *Procedia CIRP* 29: 621–26.

Molina-Azorín, José F., Juan J. Tarí, Enrique Claver-Cortés, and María D. López-Gamero. 2009. "Quality management, environmental management and firm performance: A review of empirical studies and issues of integration." *International Journal of Management Reviews* 11 (2): 197–222.

Ness, Barry, Evelin Urbel-Piirsalu, Stefan Anderberg, and Lennart Olsson. 2007. "Categorising tools for sustainability assessment." *Ecological Economics* 60 (3): 498–508.

OECD. 2010. *Guidance on sustainability impact assessment*. Paris: OECD.

OECD. 2012. "The future of eco-innovation: The role of business models in green transformation." *Background paper presented at the OECD/European Commission/Nordic Innovation Joint Workshop*, 19–20 January 2012, Copenhagen.

Osterwalder, Alexander, and Yves Pigneur. 2010. *Business model generation. A handbook for visionaries, game changers, and challengers*. Hoboken, New Jersey: Wiley.

Osterwalder, Alexander, Yves Pigneur, and Christopher L. Tucci. 2005. "Clarifying business models: Origins, present, and future of the concept." *Communications of the Association for Information Systems* 16 (1).

Pope, Jenny, Alan Bond, Jean Hugé, and Angus Morrison-Saunders. 2017. "Reconceptualising sustainability assessment." *Environmental Impact Assessment Review* 62: 205–15.

Pope, Jenny, David Annandale, and Angus Morrison-Saunders. 2004. "Conceptualising sustainability assessment." *Environmental Impact Assessment Review* 24 (6): 595–616.

Pryshlakivsky, Jonathan, and Cory Searcy. 2013. "Fifteen years of ISO 14040: A review." *Journal of Cleaner Production* 57: 115–23.

Pun, Kit-Fai. 2002. "Development of an integrated total quality management and performance measurement system for self-assessment: A method." *Total Quality Management* 13 (6): 759–77.

Ritter, Thomas, and Christopher Lettl. 2017. "The wider implications of business-model research." *Long Range Planning* 51 (1): 1–8.

Robèrt, K. H., B. Schmidt-Bleek, J. Aloisi De Larderel, G. Basile, J. L. Jansen, R. Kuehr, P. Price Thomas, M. Suzuki, P. Hawken, and M. Wackernagel. 2002. "Strategic sustainable development—Selection, design and synergies of applied tools." *Journal of Cleaner Production* 10: 197–214.

Rodríguez-Olalla, Ana, and Carmen Avilés-Palacios. 2017. "Integrating sustainability in organisations: An activity-based sustainability model." *Sustainability* 9 (6): 1072.

Schaltegger, S., C. Herzig, O. Kleiber, and J. Müller. 2002. *Nachhaltigkeit Im Unternehmen. Konzepte Und Instrumente Zur Nachhaltigen Unternehmensentwicklung*. Center for Sustainability Management (CSM) e.V, Universität Lüneburg.

Schaltegger, S., Florian Lüdeke-Freund, and E. G. Hansen. 2012. "Business cases for sustainability: The role of business model innovation for corporate sustainability." *International Journal of Innovation and Sustainable Development* 6 (2): 95–119.

Schaltegger, Stefan, Erik G. Hansen, and Florian Lüdeke-Freund. 2016. "Business models for sustainability: Origins, present research, and future avenues." *Organization and Environment* 29(1): 3–10.

Scheepens, A. E., J. G. Vogtländer, and J. C. Brezet. 2016. "Two life cycle assessment (LCA) based methods to analyse and design complex (regional) circular economy systems. Case: Making water tourism more sustainable." *Journal of Cleaner Production* 114: 257–68.

Schmidt-Bleek, Friedrich. 1994. *Wieviel Umwelt Braucht Der Mensch? MIPS - Das Maß Für Ökologisches Wirtschaften*. Basel: Birkhäuser.

Schöggl, Josef Peter, Rupert J. Baumgartner, and Dietmar Hofer. 2017. "Improving sustainability performance in early phases of product design: A checklist for sustainable product development tested in the automotive industry." *Journal of Cleaner Production* 140: 1602–17.

Schweizer, Lars. 2005. "Concept and evolution of business models." *Journal of General Management* 31 (2): 37–56.

Searcy, Cory. 2016. "Measuring enterprise sustainability." *Business Strategy and the Environment* 25 (2): 120–33.

Singh, Rajesh Kumar, H. R. Murty, S. K. Gupta, and A. K. Dikshit. 2012. "An overview of sustainability assessment methodologies." *Ecological Indicators* 15 (1): 281–99.

Teece, David J. 2010. "Business models, business strategy and innovation." *Long Range Planning* 43 (2–3): 172–94.

Uncles, Mark D., Grahame R. Dowling, and Kathy Hammond. 2003. "Customer loyalty and customer loyalty programs." *Journal of Consumer Marketing* 20 (4): 294–316.

Upward, Antony, and Peter Jones. 2016. "An ontology for strongly sustainable business models: Defining an enterprise framework compatible with natural and social science." *Organization and Environment* 29 (1): 97–123.

van Schalkwyk, Johan C. 1998. "Total quality management and the performance measurement barrier." *The TQM Magazine* 10 (2): 124–31.

Wood, Richard, and Stephen Garnett. 2010. "Regional sustainability in Northern Australia—A quantitative assessment of social, economic and environmental impacts." *Ecological Economics* 69 (9): 1877–82.

Yang, M., S. Evans, D. Vladimirova, and P. Rana. 2017. "Value uncaptured perspective for sustainable business model innovation." *Journal of Cleaner Production* 140: 1794–1804.

Yildirim, Nihan. 2017. "Organisational learning through knowledge management systems: A case study on improvement of customer support processes." *International Journal of Knowledge Management Studies* 8 (3/4): 375.

Zott, Christoph, and Raphael Amit. 2010. "Business model design: An activity system perspective." *Long Range Planning* 43 (2–3): 216–26.

Zott, C., R. Amit, and L. Massa. 2011. "The business model: Recent developments and future research." *Journal of Management* 37 (4): 1019–42.

15

REVERSING MATERIALITY: From a Reactive Matrix to a Proactive SDG Agenda

Rob van Tulder and Laura Lucht

Introduction: Overcoming the Incumbent's Curse

Leading (big) companies that apply sustainability-oriented innovation strategies could have a major—arguably decisive—impact on shaping a 'better world'. There are basically two approaches that these companies can adopt: [I] innovation as an extension of existing business models that are based on present markets and needs or [II] innovation as an anticipation of new business models based on future markets and needs. The first approach relates to more gradual processes of—often incremental—innovation, whereas the latter approach has the potential of more radical—even disruptive—forms of innovation. The first approach is based on an extrapolation of trends; the second tries to 'back-cast' on the

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basis of desired future outcomes (Holmberg and Robert 2000). The first seems the least risky strategy of the two, but is also considered to lead to stagnation in those areas of sustainability where 'transformational change', or more system approaches, is required.

The literature in this respect talks about the 'incumbent's curse': big companies that have a vested interest in the 'old way' of doing things, will consequently have great difficulties in changing and are therefore more inclined to bar change towards higher levels of sustainability—even if their leadership would be convinced that this is needed (Chandy and Tellis 2000). Incumbents fail to adapt in particular because of their inability to master new competencies and routines, due to their embeddedness within an established industry network that does not initially value the new technologies and societal ambitions. This poses a particular challenge to the leaders of these companies. Research on the incumbents' curse has shown that this is an important factor why so many seemingly 'big and powerful' companies in the end might even disappear for lack of adaptation to new realities (ibid.). This phenomenon is also popularly known as the 'Kodak-effect', the experience of the leading photography company that created the world's first digital camera but was not able (and/or willing) to change its business model accordingly. In 2012, the company went bankrupt.

However, incumbents sometimes succeed in facing radical transitions—even creating them—by investing in internal capabilities and relevant assets, by developing a proactive vision on where to go to and by redeploying and leveraging their innovative capabilities in the new technological and market domains that can be linked to particular sustainability issues (Hengelaar 2017). In short, by successfully adopting approach II they are able to 'reinvent' themselves through a particular business model innovation strategy. Philips or IBM are examples of companies that over time have 'reinvented' themselves several times. A company like Dutch Statement Mines (DSM) even changed sector three times over a number of decades—from mining, via fine chemicals to nutrition nowadays. These companies not only 'adapted' to changing (political-economic-technological) circumstances, but also were able to shape new (proto) institutions that enabled them to implement the change (De Geus 2002). An essential part of this strategy has always been to engage in partnerships and network relations with other organizations (Lawrence and Suddaby 2006) in order to engage in systemic change (Van Tulder and Keen 2018).

The integration of sustainability in the innovation strategies of companies is determined by the degree to which sustainability issues can be made 'material'. A sustainable issue is material if 'it could substantively affect the organization's ability to create value in the short, medium or long term' (IIRC 2013: 33). Corporations, however, are confronted with a large number of sustainability issues which create sizable dilemmas in determining what to address and what not (Van Tulder with Van der Zwart 2006). In the sustainability discourse, companies use so-called *materiality assessments* to determine the threshold at which specific sustainability issues are deemed so important by relevant stakeholders that they should address these in their strategy. Typically, materiality starts from the perspective of the company and prioritizes sustainability issues in direct response to stakeholder pressure.

In this chapter, we will explain (section "Materiality as a Principle") the theory and principles behind the materiality process as well as the type of strategies existing materiality approaches tend to favour (section "Materiality in Practice"). It has been found that extant materiality techniques tend to prioritize incremental over radical forms of innovation. Companies often stimulate reactive practices of issue management and consider international sustainability challenges as tactical and risk-related challenges, rather than opportunities for growth and innovation. Overly conservative strategies in general tend to increase the occurrence of an incumbent's curse.

However, we also notice a new take on the materiality challenge (section "Reversing Materiality: Applying the SDGs"), under the influence of the formulation of the 17 Sustainable Development Goals (SDGs). In September 2015, all 193 UN governments agreed upon a joint ambition for the year 2030 that ranges from poverty alleviation to effectively addressing climate change and health problems (UN 2015). The achievement of most of these goals requires transformational change. Many incumbents have actually contributed to the formulation of these goals. International organizations (Global Compact, World Business Council for Sustainable Development [WBCSD]) argue that the 17 SDGs potentially have a very important impact on the purpose of enterprises all over the world. Studies (PwC 2015; Ernst & Young 2016) reveal that more than two-thirds of (big) companies around the world are already looking favourably at aligning with the SDGs. Furthermore, 87% of a representative sample of CEOs worldwide indicated that the SDGs provide an opportunity to rethink approaches to sustainable value creation (Accenture 2016). There is also a solid business logic to this ambition: it is estimated that achieving the Global Goals could open up an estimated US$12 trillion of economic opportunities in markets that require radical systemic change such as the food and health systems or whole cities (B&SDC 2017). Companies that embrace the SDGs share the potential to become 'radical incumbents' (B&SDC 2017), but of course only in the case they are able to integrate the SDGs in their strategies in a meaningful manner.

The biggest challenge, therefore, remains to move from rhetoric to practice. This means to embed SDGs in strategic activities and not only use them for philanthropic activities. Companies that try to succeed in making the SDGs part of their strategic planning, including their innovation strategy, have to make the SDGs material. In practice, this implies that the SDG agenda is successfully integrated in the materiality assessment of companies and that companies start 'walking the talk'. This requires reversing the materiality logic from a corporate to a societal point of view. By selecting a universal agenda that will be relevant for at least 15 years, companies can channel not only their strategies, but also reap opportunities to rethink sustainable value creation and structure their sustainability efforts. Section "Reversing Materiality: Applying the SDGs" provides some examples of the way frontrunner companies are trying to integrate the SDGs in their innovation strategies. It is too early to assess the ultimate success of these approaches, but we can nevertheless conclude that reversing materiality is becoming a growing practice with promising prospects (section "Conclusion—A Promising Practice").

Materiality as a Principle

Different stakeholders have diverse and non-aligned informational needs to make effective decisions. Materiality has become a reporting principle that is intended to provide stakeholders with 'complete' and 'coherent' information to assess a company's performance (Calabrese et al. 2016; Edgley et al. 2015). Materiality is an interdisciplinary and multifaceted concept that operates as an information threshold in favour of the users of the information (Edgley 2014). It originated as an accounting and auditing concept in financial reporting. Its objective was to reduce risk to an acceptable level where its key determinant was whether the omission or misstatement would influence investor-decisions (Eccles et al. 2012). The materiality principle was introduced in the area of sustainability reporting by the Global Reporting Initiative (GRI) as part of its 2006 G3 reporting guidelines and updated in its 2011 3.1 and 2013 G4 guidelines. Materiality in this set-up is basically concerned with identifying those environmental, social and economic issues that matter most to a company and its stakeholders. It supposes that shareholders increasingly want to include the ethical perspective when taking decisions. Moreover, it acknowledges that shareholders are no longer the only stakeholders to focus on. Views of a wider group of stakeholders, such as customers, employees and communities, are taken into account. This implies a wider focus and different approach regarding what is important for business. In addition, it is intended to provide inputs for managing for the future—including a longer-term focus on issues that could affect a business strategy—and not about repeating what worked in the past (Murninghan and Grant 2013).

The fundamental function of materiality is filtering topics and prioritizing stakeholders. It therefore necessarily involves selection, inclusion and exclusion of information. This should result in reports that are centred on issues that are deemed the most critical to inform selected stakeholders of an organization (Jones et al. 2016; Eccles 2016). Consequently, it should help stakeholders to understand how sustainability issues can be a catalyst for innovation and growth and how these could be integrated in specific business activities (Bowers 2010).

Defining materiality is therefore also seen and used as a legitimating tool to change stakeholders' expectations (Manetti 2011).

The outcome of the materiality determination process is a materiality matrix. This matrix, in theory, enables a company to identify those (sustainability) issues that affect their long-term success. A materiality matrix shows all topics that are (perceived) of high, medium and low interest for the company as well as its stakeholders at this moment. It is supposed to be based on 'what matters' which is identified through a thorough internal analysis and stakeholder engagement. The archetypical materiality matrix confronts the importance of issues for stakeholders at the *Y*-axis (which identifies those topics that the company is supposed to 'talk' about) with the importance of these issues to the company on the *X*-axis (which identifies how important it is to 'walk') (Fig. 15.1). The materiality matrix then consists of at least four quadrants that present combinations of relative importance. The top right quadrant of a materiality matrix chart contains issues that are not only significant to the reporting company, but are also issues that the reporting company's stakeholders care deeply about. GRI advices companies to spend the bulk of their report (talk) about how they are addressing these issues.

Materiality in Practice

Determining materiality means being engaged in a lengthy and repetitive process that often consists of the following steps: identification of material topics, prioritization, validation and review (GRI, G4). Seeking management support and stakeholder feedback are essential conditions. Different frameworks directed at different users of the disclosed information (e.g. Sustainability Accounting Standards Board (SASB) (investors), International Integrated Reporting Council (IIRC) (investors), GRI (all stakeholders)) can be used as guidance, but there is no generally accepted standard. Neither is there a universally accepted definition of materiality in the sustainability context.

In theory, the output of the materiality determination process is the disclosure of truthful and accurate information about a company's performance and impact. In practice, this proves to be quite difficult since this information needs to be tailored to different stakeholder groups.

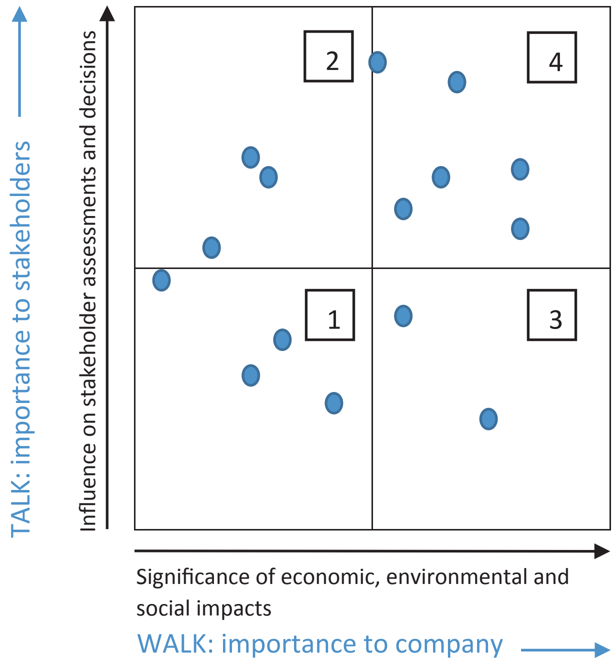

Fig. 15.1 Exemplary GRI G4 Materiality Matrix in which we position the 4 strategic options companies have and we indicate how walk and talk are related to the axes. https://g4.globalreporting.org/how-you-shouldreport/reporting-principles/principles-for-defining-report-content/materiality/Pages/default.aspx

Companies are then confronted with the question which stakeholders to select and what expectations to manage. Aligning corporate behaviour with stakeholder expectations has become a business priority (Dawkins 2005). Firms have to manage conflicting interests and objectives and articulate this in a credible way in order to drive learning and innovation (AccountAbility 2006). Sustainability reporting is considered an effective channel of communicating sustainability efforts, but a major risk is that companies only publish what management deems relevant or how they interpret and frame stakeholders' concerns. A study of AccountAbility (2015) shows that most companies are using stakeholder engagement and materiality as risk-based tools to manage reputation, predominantly responding to stakeholders' expectations and claims rather than opportunity-based tools to innovate.

Although stakeholders increasingly demand transparency in order to know the actual impact of organizations' operations, transparency is an often-cited problem when talking about the materiality process. Frequently, companies don't disclose how they determine the material issues (Mio 2010). In addition, the jury of the Dutch Transparency Benchmark, an annual research on the content and quality of sustainability reports of Dutch companies, indicated that '*Only a few companies are transparent and honest regarding their own weaknesses vis-a-vis peers. The same applies for addressing and communicating on dilemmas: every company is faced with dilemmas, but not every company is transparent on these aspects*' (MoEA 2016: 17). The dilemmas that this quote refers to relate for instance to sequencing decisions: Which issue to take up first and how much money to spend on them. Another dilemma that in particular internationally operating companies face is how to deal with issues like human rights for which great cultural and regulatory differences exist between countries (Van Tulder 2018). IIRC (2013) concludes that sustainability communications are often a PR exercise, telling feel-good stories about a selection of less relevant issues and those that are easier to address, rather than a meaningful story about value creation.

The effective use of materiality matrices in sustainability reports is highly contested. The plotting exercise contains a large number of (often subjective) assessments and selections. Manetti (2011) indicates that stakeholders are often not involved in defining the contents of the report, and it's not clear how representatives of the various groups are selected. There are also different incentives that drive the process. It may be mandatory because it is required by law (e.g. France, USA, South Africa), or voluntary as part of a sustainability reporting framework or simply to maximize the efficient use of resources. Critics indicate that materiality is not supposed to be an exercise in ticking the box. It should be about how the business activities affect the company's viability and the lives of its stakeholders. This should result in an honest representation where positive and negative impacts are being taken into account for both current and future issues. This can then be a catalyst for planning and action.[1]

Studies on the use of materiality found that they tend to be more about intent than about performance: implementation is rarely guaranteed. Matrices are often supply driven instead of based on (tacit or future) needs. They are relatively static, whilst every year priorities shift due to changing stakeholder engagement, and they don't sufficiently take into account diversity between and within stakeholder groups. Materiality matrices are regularly accumulated through consultation with a selected group of stakeholders that are willing to cooperate and participate in stakeholder meetings—but that are not necessarily the most critical or important ones. Corporate reports about the content of these stakeholder meetings hardly ever testify a discussion around serious dilemmas. Often there also exists a difference between the public matrix and the one that is being used for internal use. Furthermore, most matrices are very individualized assessments that do not show the industrial benchmarks used by peers and investors to compare performance nor key sustainability performance indicators within an industry (Bouten and Hoozée 2015; Murninghan and Grant 2013; Zhou and Lamberton 2011).

In addition, KPMG (2014) found that senior management is not always involved in the materiality assessment process. If the sustainability team is only in charge, and there is no company-wide support for the process and outcomes, the board is less likely to take sustainability issues into account when making vital decisions regarding corporate value creation and resilience. This makes the discourse less material. Ceres even claims that 'where sustainability is material to a company, boards have a fiduciary responsibility to act' (2017: 4). This implies that companies should focus on integrating sustainability into strategy and also on achieving long-term results. Other challenges as identified by KPMG are: material topics are too broad or overlap, which makes it difficult to evaluate whether companies are managing them adequately, and there are more material issues than the company can (or wants to) manage which makes it harder to understand the company's impacts and priorities.

Reversing Materiality: Applying the SDGs

By introducing the SDGs to the discourse on sustainable development, including major universal topics as defined by society in general and not only by their own (selected) stakeholders, companies are potentially taking a first step to get out of a reactive approach and to move towards a more active approach. This trend is strongly endorsed by international organizations (Organisation for Economic Co-operation and Development [OECD], World Resources Institute [WRI], WBCSD, World Economic Forum [WEF]) which emphasize that feeding the SDGs into a firm's strategic planning process is a major opportunity for a company's long-term success.

The SDGs can inform a company's materiality analysis, serve as a lens in goal-setting and help define the relevant issues for the sector, value chain or country the company is operating in. The common framework of action and language that the SDGs constitute provides a unified sense of (long-term) priorities and purpose which facilitates communication with stakeholders. The goals reflect stakeholder expectations and future policy direction at the (inter)national and regional level. Hence, advancing the SDGs can help mitigate legal, reputational and other business risks. But more importantly, it can further a better understanding of the sustainability context and enable companies to shape and steer their business activities and capture future opportunities through products and services that address global societal challenges (GRI et al. 2015; WBCSD 2015). In this way, they can engage more deeply as a positive and strong influence on society (Bakker in PwC 2015).

The engagement of big companies with the SDGs, however, still takes place in a climate of considerable distrust and scepticism as to the real motivations of companies. Are they willing to walk the talk? The 2017 Edelman Trust Barometer[2] shows that 75% of general public around the world agree that 'a company can take specific actions that both increase profit and improve the economic and social conditions in the community where it operates'. Nevertheless, research of Corporate Citizenship[3] (2017) shows that businesses have the tendency to use the SDGs for communications, but they neglect the strategic implications. Moreover, whilst 99% of the respondents said that their company was aware of the SDGs, 20% indicated that their employers had 'no plans to do anything about them'.

Sceptics—as well as the optimists—participate in a complicated discourse on the question whether (big) companies are actually willing and able to contribute to sustainable development. Companies have four strategic options (cf. Fig. 15.1):

1. Don't talk and don't walk (**Inactive**): This is the traditional (neoclassical) view on companies in which they adopt a narrow 'fiduciary duty'—with only direct and short-term responsibility to shareholders and owners without taking into account negative externalities like pollution—and consequently keep to relatively simple goals like profit maximization. This position feeds into low expectations/trust of society on the ability of companies to contribute to sustainability.
2. Talk, but don't walk (**Reactive**): This is the archetypical reason why sceptics refer to 'green-washing'—or in the case of UN initiatives 'blue-washing' (blue is the colour of the UN)—of companies. It happens when companies are not serious about their contribution to sustainability, but nevertheless suggest the opposite. This can also apply to companies that are more serious about sustainability issues, but nevertheless limit their sustainability strategy to marginal activities (and organize this for instance in their philanthropic foundation). Some are already talking about 'SDG washing'.[4]
3. Walk, but don't talk (**Active**): Faced with the societal trust gap, a number of frontrunner organizations are choosing not to talk (too much) on their societal ambition, for fear of not being able to satisfy all critics. For instance, when operating in countries with corrupt regimes, it is not always wise to be too transparent on a number of issues.
4. Talk and Walk (**Proactive**): This creates alignment of trust in case of well-communicated processes, but because most issues are very complex and take considerable time, there is no guarantee that companies that are willing to really integrate sustainability in their corporate strategy are actually able to do this. The managerial challenge becomes not only which issue to prioritize, but also what to communicate and which stakeholder to engage. Talking becomes a precondition for implementing strategic intent.

Companies that adopt options 1 and 2 reinforce the idea of an 'incumbents' curse. Options 3 and 4 could be evidence of radical incumbents that aim at disruptive sustainability. The Business & Sustainable Development Commission (2017) sees evidence that radical incumbents arise. They observe that already thirty Global Goal 'unicorns'[5]—as they call them—exist with market valuations of more than US$ 1 billion. They have made the SDGs material by integrating them into corporate strategy (option 3) as well as engaging others in their strategy to create an enabling environment (option 4). The more companies are able to line up with partners across their own sector as well as with non-commercial parties, the more they are able to create an enabling environment that can create radical or disruptive innovation (Van Tulder et al. 2014). In the latter case, coalitions of parties create new institutions (new rules of the game) that can speed up the spread of disruptive sustainability tremendously in particular when supported by (big) incumbents.

The SDGs, when used to broaden the materiality approach as an input for strategic planning and innovation, require that companies move beyond their own previous selection of material issues and don't 'repackage' old priorities to fit the SDG agenda. The challenge is not to pick the easiest, most positive or obvious goals, but to select those that can become truly material to the future business of the company (PwC 2015). Nevertheless, this is no easy task since the SDG ambition level is high and the required innovations are generally considered too systemic (which often implies radical change). This predicament can result in a short-term focus with relatively quick wins to boost the company's performance instead of transforming core business strategies. Corporations can have a 'selection bias': only those issues receive priority that they would have embraced for defensive reasons. Applying the original definition of materiality becomes additionally challenging with the inclusion of more than a limited number of SDG: How to find agreement on what actually entails corporate 'performance' (with or without societal impact) or 'complete' and 'coherent' information? The Business & Sustainable Development Commission (2017) argues that by prioritizing the right Global Goals in their strategy agenda, companies cannot only anticipate the disruption that is likely to appear in the future, but also shape the direction of the disruption to their competitive advantage due to concomitant alliances with other societal stakeholders that have helped in formulating these specific goals. Shared goals—even if companies were not part of their formulation—are a precondition for strategic alignment between potential partners (PrC 2015).

Making the SDGs 'material' not only necessitates internal change of companies, but also requires input from external alliance partners to facilitate change in the right direction. Companies can apply different strategies for this: through their CSR department, linked to strategy, in combination with their suppliers or buyers even more directly linked to their innovation strategies. Since the finalization of the SDGs, many companies have been using the SDG framework in a variety of ways, from reactive to proactive. Not many companies have really tried to make an explicit link with a possible business model innovation. But there are exceptions emerging. Take for instance the approach adopted by three Dutch frontrunner incumbents: Philips, DSM and Unilever (Table 15.1).

From interviews with all three companies, we have learned that they all initially considered all SDGs in internal discussions involving strategic departments and on occasion also suppliers. Two of the three companies linked their interest for the SDGs directly to their innovation strategy. Two also made the link between the SDGS and their supply chain and community involvement strategies. The latter strategy is often more susceptible to PR consideration. All set concrete (material) global sustainability ambitions: Philips[6] aims at creating access to health for 3 billion people by 2025; Unilever[7] aims at helping more than 1 billion people 'take action to improve their health and well-being' by 2020. DSM[8] was less specific, but identified three key areas in which the company can drive sustainable markets: nutrition, climate change and circular economy. All three companies acknowledge that their international scale and innovative capacity—the characteristics of an incumbent firm—are essential qualities to provide solutions to urgent societal challenges. A strategic support of the SDGs—i.e. explicitly linked to core activities and future markets—helps corporate leadership to align internal and external stakeholders. Whether they will succeed in this ambition and how fast, is still unknown. But all three companies have reinvented themselves several times over their more than 100-year history, which in any case makes them relevant benchmarks for measuring the success of a reversed materiality approach based on the SDGs. Not in the least because they themselves have identified the SDGs as key driver for their strategic decisions.

Table 15.1 Materiality of the SDGs and organizational alignment

Company	SDG priority (major action)	Strategic reason to choose these SDGs (company statements)	Alignment with management areas…
Philips	SDG 3 (health) SDG 12 (responsible consumption and production) SDG 13 (climate action)	We aim to improve the lives of 3 billion people a year by 2025 and have 95% of Philips revenue linked to the SDGs	Strategy and innovation: Innovation hub strategy (pilots in Africa); Community Life Centres; NGOs in health
Unilever	All SDGs	Grow our business, whilst decoupling our environmental footprint from our growth and increasing our positive social impact. 'We have an opportunity to unlock trillions of dollars through new markets, investments and innovation. But to do so, we must challenge our current practices and address poverty, inequality and environmental challenges'	Sustainable Living Plan; supply chain and marketing: sourcing of raw materials and the use of brands by consumers
DSM	SDG 2 (zero hunger) SDG 3 (health and well-being) SDG 7 (affordable clean energy) SDG12 (responsible consumption and production) SDG 13 (climate action)	Addressing the challenges of nutrition and health, climate and energy and resource scarcity drive our business and innovation strategies. We believe that our expertise in health, nutrition and materials position DSM well to actively contribute to the Sustainable Development Goals (SDGs)	Internal R&D aims and value chain; general partnering approach to 'accelerate contributions to the other 16 SDGs'

Source based on company reports

Conclusion—A Promising Practice

In this chapter, we argue that reversing materiality considerations, as well as the related techniques for involving stakeholders, is a necessary condition for using the SDGs as strong mechanism for guiding strategic planning. Companies not only have to address their own issue priorities—largely as part of a risk management strategy—but they also have to look at future possibilities as part of an opportunity-seeking strategy. Reversed materiality can consequently be based on landscaping, stakeholder engagement or scenario techniques—that have partly also been used in 'backcasting' practices. Departing from societal needs and ambitions, as defined in multi-stakeholder engagement processes, seems to create in particular promising venues for a process of internal and external alignment. It potentially breaks through an overly conservative type of materiality approach that is now practised by many companies and which might make them susceptible for the effects of an incumbent's curse. By proactively allying with societal stakeholders, leading companies actually can create their own 'enabling environment' for successfully implementing radical innovation strategies.

This chapter discussed the origins of extant materiality practices of companies, which can be traced back to accounting and risk management. The approach has also been introduced in the area of sustainability as a leading principle in the management of stakeholders and issues. The concept of materiality helps big (incumbent) companies in theory to provide a credible and accurate view of its ability to create and sustain value. It can inform company strategy and decision-making as it shows the areas where it has most substantial impact. We argued that in practice issue prioritization is often a reactive approach where companies choose to report on the relatively 'easy to solve' topics or only on those subjects that have been negatively pointed out by stakeholders. This attitude seriously lowers the ability of the company to really (materially) integrate the SDGs in their strategic planning.

The SDGs, by their set-up and framing, provide a unique opportunity for companies to engage more proactively with stakeholders. The major challenge is how to make the SDGs more 'material' than existing stakeholder approaches. We discussed some general expectations and considered some specific examples of the way frontrunner companies are using the SDGs to move away from incremental to innovation strategies that link to a more radical (systemic) change agenda. Note however, that in non-conducive circumstances a proactive strategy is more difficult to achieve and requires not only internal change but also an extended portfolio of cross-sector partnerships. Internal alignment and external alignment have to be combined and should be aimed at creating so-called proto-institutions (Lawrence and Suddaby 2006) which can create a first-mover advantage for the companies that are able to reorganize their environment (Van Tulder and Keen 2018). Reversing the materiality approach implies that companies move from an inside-out orientation in issue prioritization and strategy building to a more outside-in approach in which societal needs are considered material. Issues can only be selected as low or high priority for the short term or longer term after close consideration of the interrelation of these needs with the company's present and future possibilities to create societal value.

Notes

1. http://csr-reporting.blogspot.nl/2014/12/why-materiality-matrix-is-useless.html.
2. https://www.edelman.com/global-results/.
3. https://corporate-citizenship.com/wp-content/uploads/Accelerating-Progress-on-SDGs-2017.pdf.
4. https://oecd-development-matters.org/2017/09/25/ever-heard-of-sdg-washing-the-urgency-of-sdg-due-diligence/.
5. To mention a few: well-known companies like Nissan (in joint venture with Enel Group) or Merck, but also smaller and less well-known companies are classified as 'unicorns' like Didi Chuxing, GuaHao or MicroEnsure.
6. https://www.philips.com/a-w/about/investor/philips-investment-proposition.html.
7. https://www.unilever.com/sustainable-living/improving-health-and-well-being/.
8. https://www.dsm.com/corporate/sustainability/vision-and-strategy.html.

References

Accenture, UN Global Compact. 2016. "Agenda 2030: A window of opportunity." *The UN Global Compact-Accenture Strategy CEO survey*. Accessed July 23, 2018. https://www.accenture.com/t20161216T041642Z__w__/us-en/_acnmedia/Accenture/next-gen-2/insight-ungc-ceo-study-page/Accenture-UN-Global-Compact-Accenture-Strategy-CEO-Study-2016.pdf#zoom=50.

AccountAbility. 2006. "The materiality report: Aligning strategy performance and reporting." Accessed July 23, 2018. http://www.accountability.org/publication/materiality-report-aligning-strategy-performance-reporting/.

AccountAbility. 2015. "Beyond risk management—Leveraging stakeholder engagement and materiality to uncover value and opportunity." Accessed July 23, 2018. http://www.accountability.org/wp-content/uploads/2017/02/Beyond-Risk-Management-Stakeholder_Engagement_and_Materiality.pdf.

Bouten, Lies, and Sophie Hoozée. 2015. "Challenges in sustainability and integrated reporting." *Issues in Accounting Education* 30 (4): 373–81.

Bowers, Tom. 2010. "From image to economic value: A genre analysis of sustainability reporting." *Corporate Communications* 15 (3): 249–62.

Business & Sustainable Development Commission (B&SDC). 2017. "Better business, better world." Accessed July 23, 2018. http://report.businesscommission.org/.

Calabrese, Armando, Roberta Costa, Nathan Levialdi, and Tamara Menichini. 2016. "A fuzzy analytic hierarchy process method to support materiality assessment in sustainability reporting." *Journal of Cleaner Production* 121: 248–64.

Ceres. 2017. "Lead from the top: Building sustainability competence on corporate boards." Accessed July 23, 2018. https://www.ceres.org/resources/reports/lead-from-the-top.

Chandy, Rajesh K., and Gerard J. Tellis. 2000. "The incumbent's curse? Incumbency, size, and radical product innovation." *Journal of marketing* 64 (3): 1–17.

Dawkins, Jenny. 2005. "Corporate responsibility: The communication challenge." *Journal of Communication Management* 9 (2): 108–19.

De Geus, Arie. 2002. *The living company: growth, learning and longevity in business.* Boston: Harvard Business School Press.

Eccles, Robert G. 2016. "Sustainability as a social movement." *CPA Journal* 86 (6): 26–31.

Eccles, Robert G, Michael P. Krzus, Jean Rogers, and George Serafeim. 2012. "The need for sector-specific materiality and sustainability reporting standards." *Journal of Applied Corporate Finance* 24 (2): 65–71.

Edgley, Carla. 2014. "A genealogy of accounting materiality." *Critical Perspectives on Accounting* 25 (3): 255–71.

Edgley, Carla, Michael J Jones, and Jill Atkins. 2015. "The adoption of the materiality concept in social and environmental reporting assurance: A field study approach." *The British Accounting Review* 47 (1): 1–18.

Ernst & Young. 2016. "Sustainable Development Goals What you need to know about the Sustainable Development Goals and how EY can help." Accessed July 23, 2018. https://www.ey.com/au/en/services/specialty-services/climate-change-and-sustainability-services/ey-lets-talk-sustainability-issue-7-the-sustainable-development-goals-what-role-can-companies-play.

GRI, UN Global Compact and WBCSD. 2015. "SDG compass—The guide for business action on the SDGs." Accessed July 23, 2018. https://sdgcompass.org/.

Hengelaar, Gerbert. 2017. "The pro-active incumbent: Holy grail or hidden gem?" PhD diss., ERIM: RSM Erasmus University.

Holmberg, John, and Karl-Henrik Robert. 2000. "Backcasting—A framework for strategic planning." *International Journal of Sustainable Development & World Ecology* 7 (4): 291–308.

International Integrated Reporting Council (IIRC). 2013. "Materiality Background Paper for <IR>." Accessed July 23, 2018. http://integratedreporting.org/wp-content/uploads/2013/03/IR-Background-Paper-Materiality.pdf.

Jones Peter, Daphne Comfort, and David Hillier. 2016. "Sustainability in the hospitality industry: Some personal reflections on corporate challenges and research agendas." *International Journal of Contemporary Hospitality Management* 28 (1): 36–67.

KPMG. 2014. "Sustainable insight: The essentials of materiality assessment. KPMG International. Sustainable insight: The essentials of materiality assessment." Accessed July 23, 2018. https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2017/the-essentials-of-materiality-assessment.pdf.

Lawrence, T., and R. Suddaby. 2006. "Institutions and institutional work." In *Handbook of organization studies*, edited by S. R. Clegg, C. Hardy, T. B. Lawrence, and W. R. Nord. 2nd ed., 215–54. London: Sage.

Manetti, Giacomo. 2011. "The quality of stakeholder engagement in sustainability reporting: Empirical evidence and critical points." *Corporate Social—Responsibility and Environmental Management* 18 (2): 110–22.

Mio, Chiara. 2010. "Corporate social reporting in Italian multi-utility companies: An empirical analysis." *Corporate Social—Responsibility and Environmental Management* 17 (5): 247–71.

MoEA (Ministry of Economic Affairs). 2016. "Transparency benchmark 2016 the crystal." Accessed July 23, 2018. https://www.transparantiebenchmark.nl/sites/transparantiebenchmark.nl/files/afbeeldingen/transparantiebenchmark_eng.pdf.

Murninghan, Marcy, and Ted Grant. 2013. "Corporate responsibility and the new 'materiality'." *Corporate Board* 34 (203): 12–17.

PrC (Partnerships Resource Centre). 2015. "The state of the partnership report-2015." Rotterdam: RSM. Accessed July 23, 2018. https://www.rsm.nl/fileadmin/Images_NEW/Faculty_Research/Partnership_Resource_Centre/CSO_Can_partnerships_provide_new_venues.pdf.

PwC (PricewaterhouseCoopers). 2015. "Make it your business: Engaging with the Sustainable Development Goals. Accessed July 23, 2018. https://www.pwc.com/gx/en/services/sustainability/sustainable-development-goals/sdg-research-results.html.

United Nations, General Assembly. 2015. "Transforming our world: The 2030 agenda for Sustainable Development." A/RES/70/1.

Van Tulder, Rob, with Alex Van Der Zwart. 2006. *International business-society management: Linking corporate responsibility and globalization*. London: Routledge.

Van Tulder, Rob, Rob Van Tilburg, Mara Franken, and Andrea Da Rosa. 2014. *Managing the transition to a sustainable enterprise.* London: Earthscan/Routledge.

Van Tulder, Rob, and Nienke Keen. 2018. "Capturing collaborative challenges: Designing complexity-sensitive theories of change for cross-sector partnerships." *Journal of Business Ethics* 150 (2): 1–18.

Van Tulder, Rob. 2018. *Getting all the motives right. Driving international corporate responsibility to the next level*. Rotterdam: SMO books. https://smo.nl/publicatie/getting-all-the-motives-right-driving-international-corporate-responsibility-icr-to-the-nextlevel/.

WBCSD (World Business Council for Sustainable Development). 2015. "Reporting matters—Redefining performance and disclosure." Accessed July 23, 2018. http://wbcsdpublications.org/project/reporting-matters-2015/.

Zhou, Yining, and Geoff Lamberton. 2011. "Stakeholder diversity versus stakeholder general views: A theoretical gap in sustainability materiality conception." In *Proceedings 1st World Sustainability Forum 1–30 November 2011, Basel Switzerland*, edited by Julio A. Seijas and Maria del Pilar V. Tato. Basel: MDPI.

16

Intentional Design for Diversity as Pathway to Scalable Sustainability Impact

Wouter C. Kersten, Jan Carel Diehl and Jo M. L. van Engelen

Introduction

In this introduction, we present our storyline in narrative form and end with the central question addressed in this chapter. In the next sections, we repeat this journey in smaller steps and discuss it with references to academic research.

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If a major aim of a company is to contribute to "a better world", it in effect wants to achieve positive effects on the living situation of people and their (natural) environment. In the context of this book this implies they go for large-scale impact, in ambitious cases even global impact. Examples of corresponding issues are food systems and reduction of (plastic) waste. Some multinationals are associated with "creating a better world" but most of their efforts address the negative impact of their operations and supply chains more than product innovations towards end-consumers. Smaller companies may be driven by creating direct positive impact but many remain small in size, in part due to reasons that we discuss in this chapter.

When the aim of a company is to achieve large-scale sustainability-related impact, it will encounter a complex reality of requirements, i.e. diverse, interconnected and inherently unpredictable. To counter this complexity, companies often break down their innovation challenges into manageable chunks. They focus on a particular context (country, user segment, etc.) and think about scaling the implementation of their innovation only after first success has been achieved. This strategy gives managers the feeling that they are in control.

We acknowledge that such a simplification strategy—premature focus on an initial context, develop a product[1] to achieve local success and then develop variations for subsequent contexts—is pragmatic and tempting. In this chapter, we however argue that it is also an ill-conceived management control driven response to encountering complexity and diversity. It is in fact doubly harmful: too narrow focus has negative consequences for the quality of the sustainable innovations on the short term (initial product) and the longer term (scalability of that product). This point will be elaborated throughout this chapter.

We therefore propose to reverse this dynamic of "early simplification and later variation". We propose to immediately acknowledge the diversity of needs and perspectives that characterises global sustainability issues. This attitude then creates a conducive environment to turn creative tension caused by such diversity into informed decision-making early on in the design process. This approach thus creates the foundation for an adaptable and adaptive product architecture. These two qualities respectively refer to covering known requirements, and the inherent ability to easily adapt to future but currently unknown requirements.

Our proposition puts several notions at the centre stage: early variation of contextual perspectives (i.e. sourcing in different perspectives to develop a more holistic understanding), embracing diversity (i.e. discover these different perspectives on purpose, even if they might clash) and focus on revealing patterns (i.e. be open to identify, often unexpected, connections that emerge once different perspectives are brought together). Examples are provided throughout this chapter. These examples demonstrate how the mentioned notions are conducive to develop innovations that can achieve large-scale sustainability impact. In practice, this design perspective requires a management perspective that is aligned with it. We discuss two aspects: (1) goal setting depending on time horizon and clarity of circumstances and (2) the extent to which (central) management control may need to be ceded to play into contextual circumstances.

The main objective of this chapter is to explore and discuss rather than answer the following question: "*How can a management approach*[2] *be aligned with an adaptive product architecture if the aim is to achieve large-scale sustainability impact?*" This exploration is constructed from literature, external examples and own cases from our research in the past few years. The cases are all anonymised because of confidentiality considerations.

The Warm-Up: How to Approach the Challenge of Sustainable Innovation

The aim to substantially contribute to a better more sustainable world is by no means easy to achieve. This level of scale and thus ambition includes many interacting elements and possible issues to consider which can overwhelm anyone. Consequently such issues are frequently referred to as "grand challenges" and it takes the United Nations to rally the globe around addressing these challenges by formulating the so-called Sustainable Development Goals (Assembly 2014). Before initiating a move towards action one must realise that in such complex situations it is essential to respect the mutual interdependence (Thompson 1967) between different elements. This also implies that it is ill-advised to break up the system that is being considered early on, in order to control it or analyse only the single parts to understand what is happening (Ackoff 1973). Sustainability after all is a property of a system, not of individual elements (Ceschin and Gaziulusoy 2016).

When it comes to addressing the world's complex and wicked problems (Rittel and Webber 1973) the claim has been made that the management domain could learn from the design domain (Buchanan 1992; Cross 2001; Brown 2008). We do not discuss this claim in depth in this chapter. More importantly for now, we observe that any notable sustainability issue (climate change, access to energy, food systems, plastic waste, etc.) is experienced on a global scale, with different often interconnected manifestations and interpretations that reflect the multiformity of such issues. There is an ongoing academic debate about different levels of complexity and wickedness (Camillus 2008; Raab and Oerlemans 2016). This debate is not essential for our paper. The core point remains that issues are interrelated, as are their manifestations. The system as a whole is therefore unpredictable as are the effects of any particular measure. In other words, complex and wicked issues have no real solutions. While the relevance of complexity is acknowledged in management circles, see for example (Stacey 1996; Courtney et al. 1997; Sargut and McGrath 2011), this does not mean that managers' desire to stay in control has dissolved.

Design with Complexity, a Quick Recap

In the section after this one we present a logical next step that enables designers and management practitioners to work with the complexity of global sustainability issues. In consideration of the alleged link between design and management, we first briefly discuss a few basic concepts from the design and systems thinking domain.

Systematic variation Since the times of Leonardo da Vinci, *systematic variation* has been a known principle. In the twentieth century applying this principle was dominated by process control fixation, e.g. (Pahl and Beitz 1977; Beitz and Pahl 1992) and with a base product as starting point. Variations mostly occurred in terms of product features and market segments. This fruitful basis may need to be extended to match twenty-first-century complexity.

Design thinking An approach that was propelled from the design domain (Buchanan 1992; Cross 2001) and gained much traction in the business domain (Dunne and Martin 2006) is called design thinking. The main components are one, to put people central in the process that discovers requirements and turns these requirements into a solution and two, to use iterative testing of prototypes with actual end-users. Its initially undebated popularity has later come under some pressure, e.g. (Johansson-Sköldberg et al. 2013; Korn and Silverman 2012).

Systems thinking When considering complexity, it is relevant to acknowledge systems thinking, e.g. (Ackoff 1971, 1973; Meadows 1997, 2002; Monat and Gannon 2015). This refers to the notion that we live in systems, which are characterised by qualities like emergence of patterns, interconnections, non-linearity and self-organisation. These qualities imply that relationships between elements may be more relevant than the elements themselves and not acting on this equals ignoring reality. Later these qualities have been translated into systemic design principles as well (Jones 2014, 2015a).

Bounded rationality A practical dilemma for system(ic) thinkers is the question whether we should let limitations of human capabilities dominate the level of complexity that we want to consider. These limitations were called bounded rationality by (Simon 1969). This choice affects whether we model reality as a closed or open system, e.g. (Emery 1981). The latter reflects reality better but is generally too complex for humans to comfortably work with. In practice the desire to feel in control remains strongly present, as represented by stage-gate driven decision processes (Cooper 2008, 2014).

Systems-Oriented Design An explicit effort to let systems thinking and a design mindset converge is called Systems-Oriented Design (SOD), e.g. (Sevaldson 2014, 2017). It is inspired by soft systems methodology (Checkland 1981, 2000) which was originally developed to consider and visualise complex organisational challenges. The practice of building rich pictures and using multiple media or types of representation is at the core of both. The added value lies as much in the process as in the end result (Lewis 1992).

The Next Step: Design for Diversity, the Product and Management Perspectives

To facilitate taking the next step we summarise the main narrative from the section above in condensed form: systematic variation is a useful (design) principle, but we may not have exploited it to the fullest yet, in the light of an increasingly complex society. Complexity refers to the inherent uncertainty and interdependencies between elements in a system. Since sustainability is also complex, it can be argued that it makes less sense to strive for specific solutions than immersing oneself in a continuous process of dialogue and doing, i.e. emergent searching (Dunne and Dougherty 2012). When doing so it is likely that one will explicitly discover that many sustainability issues have different local manifestations, which are however interconnected. Therefore, when aiming to think systemically, one needs to reflect on how large the system under consideration should be to develop real progress, and whether that system should be considered as closed (manageable) or open.

We now turn to the announced approach and look at it first from a product perspective, then a management perspective.

The Product Perspective

The next step that we alluded to is an approach called Context Variation by Design (CVD). It is applicable to developing any innovation that is aimed at addressing (large-scale) issues with multiple often interconnected local manifestations. Since these are typical characteristics of sustainability issues, the approach is particularly relevant for companies with strong sustainability ambitions.

The approach is driven by several principles, previously described by, e.g. (Muller 1999), and has been developed and applied since then (Kersten et al. 2015). The most relevant aspect to emphasise here is that in order to address currently known and future unknown diversity it is helpful to apply systematic variation in terms of networks (whom to involve and from where) from the start of the design process. This notion explicitly encourages bringing together collective intelligence from multiple contexts early on. There is no given demarcation for "context". It can for example refer to a user segment, affluence level or geographical boundary.

This multi-contextual systematic network variation (Kersten et al. 2017) builds on and expands the notion of systematic variation. It furthermore recognises the importance of ensuring diversity (Sargut and McGrath 2011), acts on this recognition early on and explicitly adds the multi-contextual element. This as opposed to waiting until first design decisions have set the path (Jones 2015b). Diverting from that path to capture the essence of different local manifestations often requires substantial and repeated redesign, e.g. (Kaplinsky 2011). "Design" does not only refer to a product, so the intelligence that is gathered can contribute to all aspects, including the broader vision on the sustainability problem at hand. The common strategy with emphasis on deep intelligence from one context (Khanna 2014) is well intentioned but problematic since not explicitly considering (global) interconnections implies sacrificing real-life relevance. This negatively affects the quality of the product as well as required time and costs for implementation in multiple markets. The following case from practice illustrates this well:

Example case: Home energy management

An initially chosen market, e.g. the home country of company headquarters, is often not sufficient to create a viable business case. The need to scale and expand is therefore something companies can foresee. Many do however not incorporate this reality into action for their first steps. This may seem to make short-term sense (efficiency, time-to-first-market), but has drawbacks.

We illustrate this by an example from a company that aspired to bring a new home energy management device to market. Primarily because of lack of network abroad the founders decided to start in their home market, a large enough challenge as it was.

> The home market was not likely to be large enough to create a financially viable company so they reconsidered and soon started their expansion activities. The founders quickly discovered that the situation even in adjacent countries was quite different. This was in particular the case with respect to the wide variety of energy consuming devices, variety in connectors to a digital monitoring unit and the regulatory environment with regards to collecting and analysing data.
>
> The product in the home market only had to operate effortlessly with the most common local technologies and habits. This resulted in specific technical and design choices without yet caring about (the diversity of) possible future requirements. The choices had to be largely overturned once the company started to gain insights about the markets abroad. Later versions of their product catered for more diverse requirements but required fundamental changes in the engineering, communication and business model. This redesign investment could to a substantial extent have been avoided if a more diverse set of insights would have been taken into account from the start to develop the initial product architecture.

The suggested approach complements sustainability conducive stakeholder collaboration, e.g. (Van Tulder and Van Der Zwart 2005) and multi-disciplinary teams, e.g. (Leavy 2012) by explicitly capturing the following notions: (1) multi-contextual thinking opens doors to revealing patterns that emerge based on discussing the interconnections between information from different contexts, (2) while "chaos" may seem to reign on lower level (wide diversity of perspectives), on a "higher order" level (Johnson 2002) these new patterns can provide guidance for effective ways forward.

The intended result, conceptually, is a product architecture[3] that is adaptable to the known diversity of requirements *and* is inherently adaptive to future (unknown) requirements. It is realistic to expect that it will possess these qualities to a larger extent than a product that is based on early simplification. A few examples of these qualities are: modular products, easily adaptable range of a feature, situation dependent business models and intentionally diversified marketing around a core product. Contextual, e.g. local, differences require locally applicable products. An intentional adaptive architecture however also yields benefits based on an integrated view of the problem beyond the boundaries of any given context. To some extent, this view has been discussed related to platforms (Martin and Ishii 2002) or open-ended design (Ostuzzi et al. 2017). Similarly, the paradigm of open innovation (Chesbrough 2004) and discussion on mastering the ability to work with a variety of partners (Pagano 2009) have also initiated rethinking collaboration between companies.

We now include some brief examples from our cases that illustrate how early intentional context variation can have beneficial effects for scaling efforts as well as for the initial context that a company chooses.

Examples: Consequences of (not) using early context variation in real-life cases

Example 1: A medical device company was considering entering different countries in Africa and Western-Europe either in parallel or sequentially. By using the multi-context approach, it became obvious that it would be much smarter to capture variations in requirements for use and visualisation of data in an easily adaptable software layer, not in the physical device.

Example 2: When purposefully observing cooking habits in different countries, the different requirements with regards to necessary power (watts) became obvious. In one context, the dominant mode of cooking required long duration low power (simmering), in another the opposite, short duration, high power (frying). Because of this early identification, a simple design choice could be made that enabled both cooking modes. It is certain (see e.g. Kersten et al. 2017) that optimising a cook stove for one mode and then moving into a new territory requires expensive redesign. This has proven to severely hinder affordable scalability.

Example 3: When talking to aspiring entrepreneurs in incubators in several countries, the pattern emerged that internet connection speed and strength of social fabric between participants were roughly inversely related. Internet speed is something that an incubator cannot fully control. The insight did however yield the idea to consciously facilitate the development of *social* fabric between entrepreneurs in all incubators. It is not plausible that any single incubator could have come up with such a change.

The benefits are generally understood by people who are involved in this approach. In practice, different contexts often fall under the managerial responsibility of different business units or branches. The management perspective therefore needs to be considered as well.

The Management Perspective

This perspective includes many aspects. Within the limitations of this chapter, we focus on two: goal setting and extent of centralised control. Other aspects that could be discussed include more in-depth elaborations on financial aspects, human resource aspects, legal aspects amongst others. The chosen ones reflect the dimensions that so far in our experiences have most strongly influenced the "playing field" for designers when attempting to put sensitivity for diversity and adaptiveness higher on the agenda in their company.

Goal Setting in Relation to the Circumstances

The way how companies set goals needs to fit the situation that they face. When addressing global issues with diverse local manifestations there are many uncertainties. In this situation, one can surmise that control-oriented paradigms like S.M.A.R.T. targets (Doran 1981) make increasingly less sense, especially with narrow interpretations of Specific and Measurable (quantified).

When encountering a variety of circumstances, a framework for goal setting might need to look more like Fig. 16.1. In particular, one would have to acknowledge the reality that management control is an illusion in a world of uncertainty (Flach 2015). As Fig. 16.1 suggests, only if a company environment is stable and the time horizon is short (right below) a control paradigm *might* be suitable. Even then, changing course when required may still be desirable.

In reality, setting the right types of goals is even more complex: not only can the long-term goal be hazy and the short-term actions clear, the opposite can also be true. A long-term direction might be clear while each short-term action requires ad hoc circumstance driven decisions. While the relevance of making such distinctions might be clear, it is not necessarily common practice. As example we share the following case from the field of renewable energy in developing economy context, i.e. a "sustainable innovation".

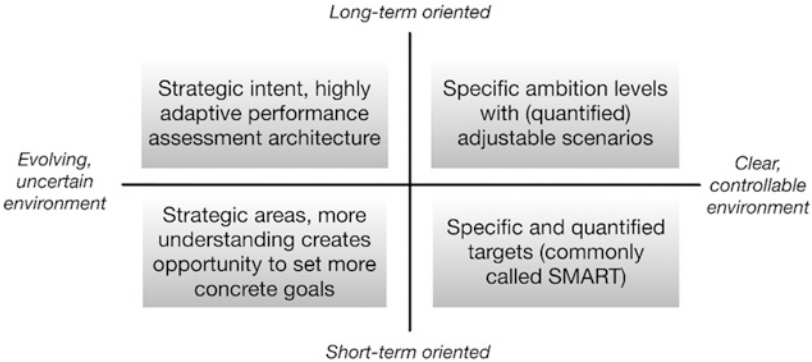

Fig. 16.1 Alignment of goal setting and level of (un)certainty of circumstances

Example: SMART is not always Wise

In a project that had gone through successful pilot-testing in an initial market (country), external funding was obtained to scale production, and sales targets were set for year 1. To facilitate scaling, budget was included to explore a second market.

During that exploration, it was discovered that there might be demand for the product in the second market if it would be offered with a leasing option. This would require changes to the business model and product design. Since funding was obtained based on "SMART" targets there was only a direct incentive to *sell a number* of units of the *initial product* within the *given period*, in the *initial market*. Hesitant customers in that market when asked revealed that a leasing option would have been appealing if not preferred. The funding arrangement did however not encourage the company to offer that option.

Effectively, using "SMART" targets complicated entering the second market and reduced uptake in the first one, because of an in hindsight poorly informed and rigid solution. A more flexible approach would have worked with strategic intent ("How to address this multiform problem") and refrained from setting specific targets until better insight was created in the system, i.e., multiple diverse contexts. Instead the agreement was based on limited, possibly accidental, success on a small scale.

In the context of global sustainability, using simple overarching metrics may be counter-productive anyway. While likely intended to provide clarity, too specific overarching metrics can easily result in a yardstick that does not match the diversity of local manifestations. Catering to a large diversity of beneficiaries is also a sign of inclusiveness. This matters in the context of sustainability since inclusiveness is explicitly stated in five Sustainable Development Goals and implicitly in six more (Assembly 2014).

Degree of Management Centralisation

As stated previously, when striving to achieve large-scale impact, besides the right product architectures, companies need appropriate governance as well. Within that domain we focus here on the level of centralised management decision-making. As suggested by Eisenhardt and Piezunka (2011) an unpredictable company environment, that is unavoidable when addressing multiform global issues, increases the need to consider the company as a complex adaptive system. This means attention is required for matters like (Eisenhardt and Piezunka 2011): redundancy *and* diversity of expertise, less focus on the traditional drivers efficiency and cost minimisation and using a few simple rules for governance with distributed autonomy to take actual decisions vis-a-vis following centralised orders. Figure 16.2 shows a rough sketch of the different combinations. Both axes depict Rigid/Centralised on one end (left and bottom) to Adaptive on the other (right and top).

We surmise that for best alignment with the design approach that we presented, we need to look at the top right quadrant. Positioning in this quadrant encourages to ask questions which activities and decisions require central guidance and which should be governed by more distributed decision-making. We first explore implications for existing companies, with several (geographically) scattered business units. The starting point is the central concept of collective intelligence in the design process to address the contextual diversity. What does this mean for choices where to allocate which management responsibility? For example:

1. Identifying relevant issues to address can occur anywhere, i.e. in distributed “units”;
2. Bringing intelligence together and identifying the most relevant contexts that can contribute this intelligence can occur by using orchestrated collaboration (Hagel III and Brown 2006);

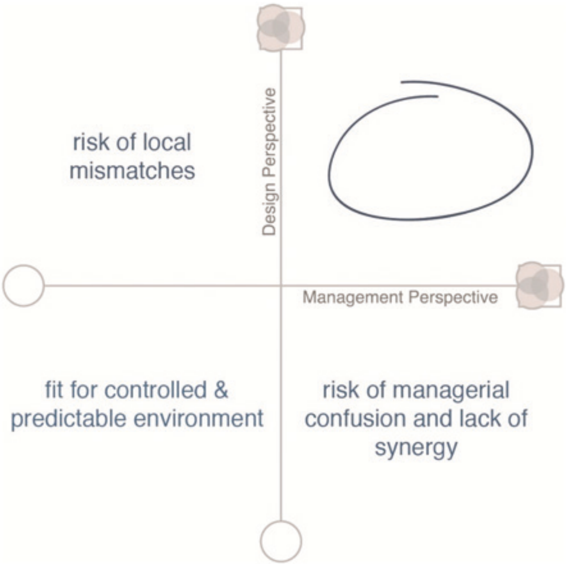

Fig. 16.2 Combinations of adaptive vs. centralised design and management perspectives

3. Creating a shared space with joint interpretation and discussion can happen centrally within that collaboration, with representation from different contexts. The focus may be more on the process than on legal ownership of the result, e.g. (Pagano 2009);
4. Consequences and implementation steps (and priorities) can initially be decided upon by the context-responsible managers;
5. Results from pilots and other experiences can be fed back to the shared (design) space to learn collectively to inform further improvements.

This suggestion respects the importance of contextual intelligence (Khanna 2014) *and* captures the benefit of the collective intelligence. Improving operational synergy between units during implementation might be worth a consideration. However, we know the two main reasons for scaling: the immensity of the need and the potential for efficiency thanks to economies of scale (Hart and Prahalad 2002). When facing the challenge of scaling sustainability minded enterprises (Bocken et al. 2016) it is relevant to ask whether economies of scale should be a logical result rather than a primary driver.

Generally, the more upfront certainty exists about shared interests between units, the larger the potential of finding collaborative synergies (Eisenhardt and Piezunka 2011). In this situation, these units can benefit from a higher degree of central coordination while still allowing for an appropriate level of local autonomies (Bradach 1997). Smaller companies that enter or aspire to a growth phase including (geographical) scaling need to ask themselves similar questions about the suitability of centrally coordinated efficiency driven processes versus distributed intelligence that is brought together when relevant. For these companies as well, more expected diversity in contextual requirements increases the relevance of working like a complex adaptive system rather than with a high level of centralised management control. This implies they have to start learning about how to effectively apply concepts like non-linearity, emergence and self-organisation (Inigo and Albareda 2016), the same that were mentioned in section "The Warm-Up: How to Approach the Challenge of Sustainable Innovation" as core principles of systems thinking.

Based on this brief exploration, we close with a suggestion how a start-up might scale out in practice and what this could mean for the choices where to allocate which responsibility in a way that is aligned with the presented design approach.

Outlook: Aligning adaptive design and management approaches for a start-up

A start-up that aims to address a global sustainability related issue can anticipate that it will encounter diverse needs. It can therefore gather like-minded but contextually dispersed intelligence at the start of its innovation process, for example in an accelerator (Radjou and Prabhu 2015). This dispersed intelligence can come from people who are interested to implement a similar concept in different regions and are open to seek synergy. Preferably they do not have a detailed business concept and no one is so far ahead that an initiator-replicator hierarchy exists. Developing the product architecture would then be guided by collective intelligence instead of just the ideas of the original founder. This would be beneficial for the initial quality of this architecture and its potential adaptiveness.

The group of aspiring entrepreneurs could then together co-develop the contours of a loosely coupled distributed structure as basis for next phases of operational development.

What Next?

How might practitioners as well as academics build on these insights? An important next step has to be taken by practitioners. If they feel positively intrigued by the principle of adaptiveness they are the ones that need to start actively aligning an adaptive product design architecture and a management approach that allows the benefits of such an architecture to materialise. One might compare this effort to considering the enterprise as a wheel instead of a solid block. The former can be moved more rapidly and easily than the latter, but there are fewer certainties where you end up so this does require entrepreneurial courage.

To support this approach and use by practitioners we however also suggest that academics continue with conducting research along these lines. The aforementioned work on considering sustainable innovation as a complex adaptive system (Inigo and Albareda 2016) will be useful input for this. The research should continue to explore what constitutes a suitable interplay between management and design approaches to enable companies to let their innovations achieve substantial scale and therefore transform the world for the better.

Notes

1. Throughout the chapter product can refer to a physical product, a service or any product-service combination.
2. We focus on "management" aspects because within the broad business domain "management" is most explicitly related to "being in control". We expect this to be a relevant aspect to explore.
3. Be reminded that "product" architecture refers to combination of products, services and business models.

References

Ackoff, Russell L. 1971. "Towards a system of systems concepts." *Management Science* 17 (11): 661–71.

Ackoff, Russell L. 1973. "Science in the systems age: Beyond IE, OR, and MS." *Operations Research* 21 (3): 661–71.

Assembly, UN General. 2014. "Report of the open working group of the general assembly on sustainable development goals." *General Assembly Document A/69/970*, New York 12.

Beitz, W., and G. Pahl. 1992. *Engineering design: A systematic approach*. London: The Design Council.

Bocken, Nancy M.P., Alison Fil, and Jaideep Prabhu. 2016. "Scaling up social businesses in developing markets." *Journal of Cleaner Production* 139: 295–308.

Bradach, Jeffrey L. 1997. "Using the plural form in the management of restaurant chains." *Administrative Science Quarterly* 42 (2): 276–303.

Brown, Tim. 2008. "Design thinking." *Harvard Business Review* 86 (8): 84–92.

Buchanan, Richard. 1992. "Wicked problems in design thinking." *Design Issues* 8 (2): 5–21.

Camillus, John C. 2008. "Strategy as a wicked problem." *Harvard Business Review* 86 (5): 98.

Ceschin, Fabrizio, and Idil Gaziulusoy. 2016. "Evolution of design for sustainability: From product design to design for system innovations and transitions." *Design Studies* 47: 118–63.

Checkland, Peter. 1981. *Systems thinking, systems practice*. Chichester: Wiley.

Checkland, Peter. 2000. "Soft systems methodology: A thirty year retrospective." *Systems Research and Behavioral Science* 17 (S1): S11.

Chesbrough, Henry. 2004. "Managing open innovation." *Research-Technology Management* 47 (1): 23–26.

Cooper, Robert G. 2008. "The stage-gate idea-to-launch process—Update, what's new and NexGen Systems." *Journal of Product Innovation Management* 25 (3): 213–32.

Cooper, Robert G. 2014. "What's next? After stage-gate." *Research-Technology Management* 57 (1): 20–31.

Courtney, Hugh, Jane Kirkland, and Patrick Viguerie. 1997. "Strategy under uncertainty." *Harvard Business Review* 75 (6): 67–79.

Cross, Nigel. 2001. "Designerly ways of knowing: Design discipline versus design science." *Design Issues* 17 (3): 49–55.

Doran, George T. 1981. "There's a S.M.A.R.T. way to write management's goals and objectives." *Management Review* 70 (11): 35–36.
Dunne, Danielle D., and Deborah Dougherty. 2012. "Organizing for change, innovation and creativity." In *Handbook of organizational creativity*, 569–83. London: Elsevier.
Dunne, David, and Roger Martin. 2006. "Design thinking and how it will change management education: An interview and discussion." *Academy of Management Learning & Education* 5 (4): 512–23.
Eisenhardt, Kathleen M., and Henning Piezunka. 2011. "Complexity theory and corporate strategy." *The Sage handbook of complexity and management*, 506–23.
Emery, Frederick E. 1981. *Systems thinking: Selected readings.* Harmondsworth: Penguin Books.
Flach, John M. 2015. "Supporting self-designing organizations." *Journal of Design, Economics and Innovation* 1 (2): 95–99.
Hagel III, John, and John Seely Brown. 2006. "Globalization & innovation: Some contrarian perspectives." Prepared for the annual meeting of the World Economic Forum in Davos, Switzerland.
Hart, Stuart, and C. K. Prahalad. 2002. "The fortune at the bottom of the pyramid." *Strategy + Business* 26 (1): 54–67.
Inigo, Edurne A., and Laura Albareda. 2016. "Understanding sustainable innovation as a complex adaptive system: A systemic approach to the firm." *Journal of Cleaner Production* 126: 1–20.
Johansson-Sköldberg, Ulla, Jill Woodilla, and Mehves Çetinkaya. 2013. "Design thinking: Past, present and possible futures." *Creativity and Innovation Management* 22 (2): 121–46.
Johnson, Steven. 2002. *Emergence*. New York: Scribner.
Jones, Peter. 2014. "Systemic design principles for complex social systems." In *Social systems and design*, 91–128. Tokyo: Springer.
Jones, Peter. 2015a. "Design research methods for systemic design: Perspectives from design education and practice." In *Proceedings of the 58th annual meeting of the ISSS-2014 United States*.
Jones, Peter. 2015b. "Designing for X: The challenge of complex socio-X system." *Journal of Design, Economics and Innovation* 1 (2): 101–4.
Kaplinsky, Raphael. 2011. "Schumacher meets Schumpeter: Appropriate technology below the radar." *Research Policy* 40 (2): 193–203. http://doi.org/10.1016/j.respol.2010.10.003.

Kersten, Wouter, J. C. Diehl, and Jo Van Engelen. 2017. "Putting the horse in front of the wagon." Relating Systems Thinking and Design (RSD6) Symposium, 18–20 October, Oslo, Norway.

Kersten, Wouter C., Marcel R. M. Crul, Jan Carel Diehl, and Jo M. L. Van Engelen. 2015. Context variation by design, working paper version 4.0. Delft University of Technology, Delft.

Kersten, Wouter C., Nguyen H. Long, J. C. Diehl, Marcel R. M. Crul, and Jo M. L. Van Engelen. 2017. "Comparing performance of biomass gasifier stoves: Influence of a multi-context approach." *Sustainability* 9 (7): 1140.

Khanna, Tarum. 2014. "Contextual intelligence." *Harvard Business Review* 92 (9): 58–68.

Korn, Melissa, and Rachel E. Silverman. 2012. "Forget B-School, D-school is hot." *Wall Street Journal*. http://www.wsj.com/articles/SB10001424052702303506404577446832178537716.

Leavy, Brian. 2012. "Collaborative innovation as the new imperative—Design thinking, value co-creation and the power of 'pull'." *Strategy & Leadership* 40 (2): 25–34.

Lewis, P. J. 1992. "Rich picture building in the soft systems methodology." *European Journal of Information Systems* 1 (5): 351–60.

Martin, Mark V., and Kosuke Ishii. 2002. "Design for variety: Developing standardized and modularized product platform architectures." *Research in Engineering Design* 13 (4): 213–35.

Meadows, Donella. 1997. "Places to intervene in a system." *Whole Earth* 91 (1): 78–84.

Meadows, Donella. 2002. "Dancing with systems." *Systems Thinker* 13: 2–6.

Monat, Jamie P., and Thomas F. Gannon. 2015. "What is systems thinking? A review of selected literature plus recommendations." *American Journal of Systems Science* 4 (1): 11–26.

Muller, Peter C. 1999. "Team-based conceptualization of new products." Ph.D., University of Groningen.

Ostuzzi, Francesca, Lieven De Couvreur, Jan Detand, and Jelle Saldien. 2017. "From design for one to open-ended design: Experiments on understanding how to open-up contextual design solutions." *The Design Journal* 20 (Supp1): S3873–83.

Pagano, Alessandro. 2009. "The role of relational capabilities in the organization of international sourcing activities: A literature review." *Industrial Marketing Management* 38 (8): 903–13. http://doi.org/10.1016/j.indmarman.2009.02.007.

Pahl, Gerhard, and Wolfgang Beitz. 1977. Konstruktionslehre (English title: Engineering design. Translated by Arnold Pomerans KW). Springer Verlag, English edition: The Design Council, Heidelberg, English edition: London.

Raab, Jorg, and Leon A. G. Oerlemans. 2016. "Shades of wickedness: Attempting to advance the conceptualization and operationalization of wicked problems."

Radjou, Navi, and Jaideep Prabhu. 2015. *Frugal innovation: How to do more with less*. United States: The Economist.

Rittel, Horst W., and Melvin M. Webber. 1973. "2.3 planning problems are wicked." *Polity* 4: 155–69.

Sargut, Gökçe, and Rita Gunther McGrath. 2011. "Learning to live with complexity." *Harvard Business Review* 89 (9): 68–76.

Sevaldson, Birger. 2014. "Holistic and dynamic concepts in design: What design brings to systems thinking." *Relating Systems Thinking to Design*: 1–16.

Sevaldson, Birger. 2017. "Redesigning systems thinking." *Form Akademisk-Research Journal of Design and Design Education* 10 (1): 1–23.

Simon, Herbert A. 1969. *The sciences of the artificial*. Cambridge, MA: MIT Press.

Stacey, Ralph D. 1996. *Complexity and creativity in organizations.* San Francisco: Berrett-Koehler.

Thompson, James D. 1967. *Organizations in action: Social science bases of administrative theory.* New York: McGraw-Hill.

Van Tulder, Rob, and Alex Van Der Zwart. 2005. *International business-society management: Linking corporate responsibility and globalization.* London: Routledge.

17

How Firms' Strategic Environmental Goals Influence Product Innovation

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Introduction

On a global scale, sustainable manufacturing has attracted increasing attention, both among managers and policymakers (Jovane et al. 2008; Eccles

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and Serafeim 2013). This is reflected in the UN Sustainable Development Goals, which, for example, indicate the need to focus on 'responsible consumption and production'. Despite this increasing political interest, there is a lack of knowledge regarding adequate strategies for how firms can implement sustainable innovation in a broader sense (Bocquet et al. 2017). Therefore, the question arises if improvements or internal strategies towards sustainable development affect the product innovation performance of firms.

For example, Patagonia and TOMS have strategically approached sustainability and reaped the benefits thereof (Hwang et al. 2016). Patagonia for instance has launched anti-consumerist advertisements, which have spurred product demand. Also, TOMS has focussed specifically on the social aspect of sustainability, promising that each sold item will contribute to a better life in the developing world, for example, by providing safe birth and eye treatments. As a further example, Apple has disclosed life cycle assessment studies of each of its products, which make users aware of the environmental impact (Apple 2018).

By contrast, many firms do not focus on creating environmentally friendly strategies, because in most cases their environmental protection activities are being compelled in response to external pressure and regulations imposed by institutions like the EU (Ambec et al. 2013; European Commission 2014). Current regulations by the EU include the improvement of resource efficiency and enhancement of the production of clean and efficient energy (Diedrich et al. 2011; European Commission 2014). Further EU regulations aim to increase environmental accounting of firms with more than 500 employees, which now need to report non-financial information (European Commission 2016).

Beyond complying with such external regulations, the development of an internal strategic approach to sustainability can be costly for firms (Walley and Whitehead 1994). The main argument supporting this assumption is that environmental improvements 'almost always require firms to allocate some input (labour, capital) to pollution reduction, which is unproductive from a business perspective' (Ambec and Barla 2006: 43). Due to this assumption, post-war corporate culture saw environmental strategies as a burden which would eventually hurt the financial performance of firms (Orr 1992; Eccles et al. 2014).

However, adopting a strategic innovation approach can also be an opportunity, as it may benefit firms and their products in the long run

(Roncha and Radclyffe-Thomas 2016). Therefore, and in general, in recent years policymakers have aimed to foster the environmental aspects of innovation within the private business sector and particularly the manufacturing industry (e.g. European Commission 2014). In this context, existing research has already identified policy-related factors that drive successful product innovation by firms focussing on the environmental aspect (Bossle et al. 2016; De Medeiros et al. 2014; Dangelico 2016). However, an important research gap exists concerning the question of how internal strategic environmental goals affect firms' product innovation. To investigate this research gap in this chapter, we define firms' internal 'strategic environmental goals' as corporate mid- and long-term aims that ensure that negative impacts and risks for the natural environment as well as product users and employees are reduced or avoided.

In the current economy, focussing on strategic environmental goal development might be beneficial, as any activity related to product innovation is of great interest to many firms (European Commission 2018). New research findings in this so far neglected field can help firms understand the potential benefits of strategic environmental goals for their product innovation activities. Because of the insight managers and researchers can gain from such new research findings, the objective of this chapter is to investigate and discuss the relationship between strategic environmental goals and product innovation in manufacturing firms. Manufacturing firms are of particular interest in this study, because they are the main exploiters of natural resources while manufacturing products for other businesses or consumers (Hart 1995).

Literature Review

The vast amount of studies on product innovation success factors (e.g. Cooper and Kleinschmidt 1995; Calantone et al. 1995; Kline and Rosenberg 2009; Tidd and Bessant 2013; Smith 2015) generally do not consider firms' internal strategic environmental goals as factors influencing the development of product innovation. However, over the last decade, a few studies have started to investigate whether or not focussing on environmental goals is beneficial to firms' product innovation activities in a wider sense (Ambec and Lanoie 2008; Lampikoski 2012; Ghisetti and Rennings 2014).

These recent studies have demonstrated that firms mainly have been forced by external regulation to implement environmental aspects, for example, technical solutions for reducing the energy consumption of buildings (Ornetzeder and Rohracher 2006). In addition, Lanoie et al. (2011) and Ambec et al. (2013) have attempted to empirically examine Porter's hypothesis that firms take into consideration external regulations in their product innovation and/or further activities, which influences their manufacturing processes.

The above-mentioned studies on environmental innovation have failed to investigate how firms' internal environmental goals influence their development of product innovation in general, which is not environmental innovation by definition (Ambec et al. 2013; Kemp and Pearson 2007; Arundel and Kemp 2009). This neglected aspect is of great relevance to managers and researchers, because it is plausible that managers in manufacturing firms would pay more attention to environmental goals if they knew that these goals would benefit their overall product innovation activities (Ambec and Lanoie 2008).

Another main argument in the reviewed literature is that there is no contradiction between internal environmental goals of firms and improved product innovation activities (Gerstlberger et al. 2016; Horbach et al. 2012). This argument is basically in line with the assumption of Porter and van der Linde (1995), who state that environmental regulation does foster innovation and thus enhances firms' competitive advantage. Multiple studies on Porter's hypothesis reveal, for example, a reduction in energy and material consumption during production and/or product use, which also seems relevant with regard to product innovation (e.g. Ambec et al. 2013; Gerstlberger et al. 2014). In addition, a more recent contribution by Porter and Kramer (2011), 'creating shared value', links societal needs (including environmental aspects) to firms' innovation management in general. However, the opposite argument can also be found in the more theoretical economic literature, namely that environmental goals may rather constrain than foster firms' product innovation due to the increased complexity of innovation-related decisions and activities (e.g. Walley and Whitehead 1994; Karvonen 2001).

Hypothesis Development

We take as our starting point for the development of hypotheses the established literature on success factors within new product development (Cooper and Kleinschmidt 1995; Cooper et al. 1999, 2002; Ritter and Gemünden 2004). This literature has identified strategic goal setting and portfolio management as important success factors of new product development projects besides input factors like internal and external R&D and upfront (e.g. marketing research) activities. Finally, our hypothesis on internal strategic environmental goals is informed by more recent literature on the internal drivers of firms' environmental product development or product innovation ('eco-innovation') (Dangelico 2016; Gerstlberger et al. 2014).

Recent eco-innovation literature's theoretical argument for considering internal strategic environmental goals potential drivers of product innovation refers to possible approaches to how to integrate additional product- and production-related environmental information into firms' innovation management processes (Dangelico 2016; Dangelico and Pujari 2010). Including such additional environmental information, for example, data referring to energy and/or material consumption during the production and/or use of newly developed products, can support not only eco-innovation, but also product innovation in general.

The reason for such a general, positive effect of additional environmental information on product innovation is the potential financial effects regarding new product characteristics like production cost and selling price (Dangelico and Pujari 2010). For example, a considerable material reduction of a newly developed product (compared to an already existing reference product) will typically also lead to a significant reduction in the production costs for this new product (Præst Knudsen and Gerstlberger 2015). Firms' internal strategic environmental goals can serve as a mechanism that 'force' the various departments responsible for a firm's production and new product development to systematically collect, document and integrate relevant environmental data into the respective firm's innovation management processes (Dangelico 2016; Dangelico and Pujari 2010; Præst Knudsen and Gerstlberger

2015). In the eco-innovation literature, such material and/or energy reductions in terms of production and/or use of newly developed product are sometimes labelled economic and environmental 'win-win situations' (e.g. Horbach 2008).

Based on the above theoretical arguments and the findings of our literature review we have formulated the following hypothesis:

H1 Manufacturing firms' internal strategic environmental goals are positively correlated with new product introduction.

When firms set their own internal strategic environmental goals, internal R&D departments are often challenged by the limitation of little input from their part for the actual environmental goal development process. They may need to include specific technological input (e.g. regarding material selection or energy efficiency) in firms' product innovation activities. This specific input forces many manufacturing firms to further formalise their internal R&D activities (De Marchi 2012). Other internal sources, such as documentation of practical experiences from production processes, often cannot provide the necessary technological input for complex innovation tasks that internal R&D can. Furthermore, both previous studies on success factors of new product development in general and on firms with proactive innovation strategies in particular have shown that systematic and strategic management of firms' product portfolios (see also the argumentation above) is an important characteristic of successful product-innovative firms (Aragón-Correa 1998; Chen et al. 2012; Cooper et al. 1999, 2002).

In line with the above argumentation, we have formulated the below hypotheses. We have also included internal R&D activities and the composition of firms' product portfolio (in terms of 'old' and 'new' products) as two further drivers of new product introduction in our analysis (e.g. Calantone et al. 1995; Tidd and Bessant 2013; Smith 2015). These additional considerations lead to H2a and H2b:

H2a Manufacturing firms' internal R&D activities are positively correlated with new product introduction.

H2b Manufacturing firms' product portfolio composition is positively correlated with new product introduction.

Methodology

For the quantitative analysis of this study, we have used the Danish part of the European Manufacturing Survey (EMS) 2015 dataset. In addition, we have also conducted qualitative interviews with managers of Danish manufacturing firms, the results of which will be presented after the quantitative findings of the study.

Survey Design and Quantitative Findings

We investigated our hypotheses based on Danish data provided in the 2015 EMS. Focussing on the European manufacturing industry is highly relevant to this study and of high interest to both managers and policymakers as well as researchers in the field of sustainable innovation, due to its still large share of the global industrial production (EUROSTAT 2016). Furthermore, many leading innovative firms with strong environmental ambitions continue to have their headquarters in Europe (De Marchi 2012; ICF Consulting Services 2016).

The EMS is a multi-topic and country survey organised by a consortium of European research institutes and universities every third year (Fraunhofer ISI 2016). The EMS covers detailed information on the implementation of specific technologies, such as energy efficiency and production planning technologies, product innovation and environmental goals for product innovation. The EMS is exclusively targeted at plants in manufacturing sectors with 10 or more employees. The number of cases in the logistic regression analysis that we performed using an EMS 2015 sample was $N = 150$.

The binary dependent variable for the logistic regression model was 'introduction of new product(s) in 2012-2014' (yes/no; OECD 2005). Our main independent variable was the environmental goals of a firm (see research model, Fig. 17.1). Based on Horbach (2008) we have measured strategic environmental goals by focussing on four items. These four items are: (i) amount of used material in production, (ii) type of used material in production, (iii) energy consumption during product use and (iv) negative environmental impact of the product during use (Cronbach's Alpha = 0.726). When measuring the strategic environmental goals, we used a five-point scale ranging from low relevance (1) to high relevance (5). For our logistic regression model (see Table 17.1), we included these items in an aggregated three-point scale.

Furthermore, we included two independent variables in our logistic regression model: (i) 'Did your firm accomplish research and development (R&D) internally in 2014?' (OECD 2005) and (ii) 'are there products that have been in the firm's portfolio for more than 10 years?' (Hart 1995). Also, these additional independent variables are dummies with yes and no as possible values.

The quantitative findings that we present in this chapter (Table 17.1) underline that strategic environmental goals are significantly and positively correlated with new product introduction in manufacturing firms. Based on this main finding of our quantitative statistical analysis, we can confirm our first and main hypothesis, H1.

Additionally, firms' internal R&D activities and, but only by trend, the composition of their product portfolio in terms of old and new

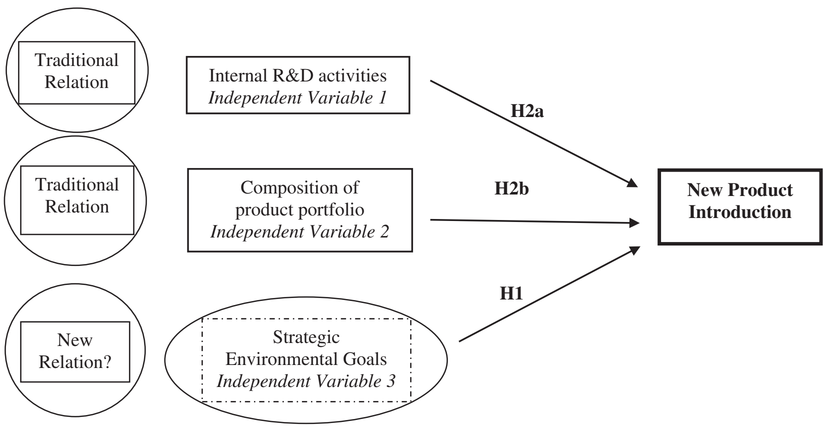


Fig. 17.1 Research model

Table 17.1 Logistic regression findings

Dependent variable name	Introduction of new product/s 2012–2014	
Independent variable name	Exp(B)	Standard error
Strategic environmental goals	7.823*	.856
Did your firm accomplish research and development internally in 2014?	2.627*	.404
Are there products that have been in the firm's portfolio for more than 10 years?	3.114	.678
Constant	2.023**	.002
Coefficient	**Value**	
Nagelkerke R^2		.154
Hosmer-Lemeshow Test		Chi-square = 5.4 Significance = .143
Predicted Percentage Correct (Overall)		74.0%
The correlation table for the variables in the applied logistic regression model does not reveal any problematic values (Field 2000)		

$N = 150$. $^{*}p \leq .05$. $^{**}p \leq .01$

products (10% significance level) show significant and positive correlations with environmental goals and product innovation performance. These additional findings of our quantitative statistical analysis enable us to also confirm our second hypothesis, H2a.

However, regarding our third hypothesis, H2b, these further statistical results demonstrate that manufacturing firms' product portfolio composition (in terms of old and new products) only tends to be positively correlated with new product introduction. Therefore, we can only conditionally accept H2b. One possible explanation for this last finding could be that a more detailed scale (beyond the rather simple differentiation between 'old' and 'new' products in a manufacturing firm's product portfolio, as in the EMS 2015 questionnaire which we could apply for this study) is needed to measure the effects of firms' product portfolio composition on new product introduction more precisely in future studies (e.g. Cooper et al. 1999).

Supplementing Qualitative Results

Due to the limitations of the EMS dataset, which we could apply for our quantitative analysis, our dependent variable 'new product innovation' (yes/no) does not consider in detail how new products are introduced by firms. Therefore, we do not know if the Danish EMS 2015 firms in our sample introduced their new products in 2012–2014 on their own or in cooperation with external partners, for example, customers of suppliers or in both ways.

In addition to the above-summarised quantitative findings, we have analysed some qualitative interviews as complementary investigation regarding our research objective. Parts of these qualitative interviews have already been used in the study by Goduscheit et al. (2015). To identify appropriate interview partners, firms that in the 2012 Danish EMS indicated being interested in both (i) the introduction of new products and (ii) the explicit formulation of strategic environmental goals were contacted. After having identified those firms, we called them in the summer of 2015 to gauge their interest in an additional study and to identify firm experts in the area of new product development and corporate environmental goals. Finally, five Danish production firms, which showed the best fit with the research objective of this study, were chosen for additional analyses of qualitative interviews. Following the described process, we ensured that the interview findings would further enhance our understanding of our research topic and in this way support and complement our quantitative survey data.

The five selected interviews lasted approximately 30–60 minutes and were transcribed in full. These five interviews covered the following firms and interviewees in more detail:

1. Basic metals and fabricated metal products industry, with metal and plastic material as main products (*CEO*).
2. Basic metals and fabricated metal products industry, with metal working, laser cutting and robot welding as main products (*CEO*).
3. Machinery and equipment industry with devices for industry kitchens as main products (*Sales Director*).

4. Electrical machinery and apparatus industry with solutions for utility companies as main products (*Head of Department*).
5. Medical, precision and optical instruments industry with metering devices for industrial purposes as main products (*Managing Director*).

The results of the analysed qualitative interviews indicate, first, that the formulation of internal strategic environmental goals has supported the given firms' systematic collection, documentation and use in product innovation processes of both economically and environmentally relevant data regarding the energy and/or material consumption of newly introduced products. As an example of this inclusion of additional data related to energy and/or material consumption in new product development processes, one interviewee mentioned that the head of the R&D department of the respective firm 'was asked to provide solid evidence for their newly developed product in terms of energy consumption' by the top management based on the firm's strategic environmental goals. A further example of the inclusion of additional economically and environmentally relevant data in firms' product innovation processes due to internal strategic environmental goals 'is the focus on material use reduction', as the interviewee from another manufacturing firm stated.

Finally, also the implementation of corporate environmental certifications by the investigated manufacturing firms has been driven by top managers' efforts to formulate internal strategic environmental goals and introduce new products in close cooperation with both internal (e.g. R&D, production and marketing/sales departments) and external (e.g. key customers and suppliers) stakeholders. In this context, three of the interviewees indicated that 'certifications like the ISO 14001 certification have pushed the effort to not only become eco-friendlier within the boundaries of the firm but also to seek to innovate products that are in line with the highest standards within use of resources, and emissions'. In these cases, certifications like ISO 14001 provided a supportive framework for increasing the level of producer-customer inter-firm information and knowledge transfer by setting standards for the form and quality of the exchanged data.

Discussion

Based on the presented quantitative and supplementing qualitative results, a first contribution of this chapter is that certain corporate capabilities are synergetic between product innovativeness in general and the introduction of new products with specific environmental ambitions. This first result is partly in line with literature on the drivers of environmental product innovation or 'eco-innovation' (Pujari et al. 2003; Dangelico 2016). More in detail, our study shows the significant positive correlation between manufacturing firms' internal strategic environmental goals and new product introduction in general, while controlling for firms' internal R&D activities and the composition of product portfolios (in terms of old and new products) as established product innovation success factors.

Second, this study contributes to the still emerging literature on sustainable innovation with the finding that manufacturing firms' strategic environmental goals are not only positively correlated with eco-innovation (as can be expected and is known from the literature), but also with new product introduction in general. Based on our secondary analysis of qualitative interviews, one explanation for this second contribution is an increased degree of producer-customer (inter-firm) knowledge transfer in different kinds of environmental and general innovation projects in firms with strategic environmental goals. Such increased inter-firm knowledge transfer indicates that firms' strategic environmental goals not only have implications for the content of innovation projects, but also for the form and intensity of inter-firm cooperation and knowledge transfer during innovation projects in general.

Conclusion

Contributions to Firms' Strategic Environmental Goals for Theory and Practice

The results shown and discussed in this chapter can help managers of manufacturing firms to better see and exploit the advantages and opportunities offered by strategic environmental goals with regard to product innovation development. In contrast to the more traditional opinion of managers working with innovation processes (Ambec et al. 2013; Walley and Whitehead 1994), we reveal in this chapter that focussing on strategic environmental goals also enhances the general product innovation activities of manufacturing firms. This result is substantially important for managers in the form of the following practical *take-aways*:

- Top managers (e.g. CEOs) and managers responsible for areas such as R&D, production and marketing can use this insight to identify and implement strategic environmental goals for their firms, which will lead to significant reductions in energy and/or material consumption in specific fields related to new product development (e.g. production, use, product refurbishment, maintenance of products and/or production facilities).
- Besides such potential reductions in energy and/or material consumption, also opportunities to avoid harmful substances (e.g. temperature regulation) during production processes and/or to simplify the recycling of used products can form part of firms' strategic environmental goals.

Both internal (e.g. R&D, production and marketing/sales departments) and external (e.g. key customers and suppliers) stakeholders of manufacturing firms should be involved in the identification and implementation of internal strategic environmental goals, depending on the specific internal and external cooperation networks of the respective firms.

Limitations of the Study and Suggestions for Future Research

Finally, we would like to point to the limitations of our study and to some suggestions for future research. We have studied Danish manufacturing firms. Although Denmark is an important EU and

OECD country in terms of product innovation in general (European Commission 2015) and environmental innovation (State of Green 2016), a quantitative and/or qualitative follow-up analysis could extend our findings. Furthermore, we delivered our EMS 2015 questionnaire to single respondents (production directors) in Danish manufacturing firms.

We encourage researchers who plan to conduct follow-up studies to test alternative, preferably also multi-item measures. Follow-up survey studies could develop and realise research designs with multiple respondents from the same manufacturing firm/plant. Beside production directors, CEOs or other top management members could be included as respondents. Another important recommendation for future studies refers to the type of applied data. We used the data of a cross-sectional manufacturing survey for our logistic regression analyses. Future research could also apply longitudinal survey data to extend our results. Finally, mixed-method studies in single or multiple countries could include additional research questions and dimensions, compared to our study (e.g. Del Río et al. 2015).

References

Ambec, Stefan, and Philippe Barla. 2006. "Can environmental regulations be good for business? An assessment of the Porter hypothesis." *Energy Studies Review* 14 (2): 42–62.

Ambec, Stefan, and Paul Lanoie. 2008. "Does it pay to be green? A systematic overview." *Academy of Management Perspectives* 22 (4): 45–62.

Ambec, Stefan, Mark A. Cohen, Stewart Elgie, and Paul Lanoie. 2013. "The Porter hypothesis at 20: Can environmental regulation enhance innovation and competitiveness?" *Review of Environmental Economics and Policy* 7 (1): 2–22.

Apple. 2018. "Environmental responsibility report". Accessed July 13, 2018. https://www.apple.com/sg/environment/pdf/Apple_Environmental_Responsibility_Report_2018.pdf.

Aragón-Correa, Juan Alberto. 1998. "Strategic proactivity and firm approach to the natural environment." *Academy of Management Journal* 41 (5): 556–67.

Arundel, Anthony, and René Kemp. 2009. "Measuring eco-innovation." Accessed November 10, 2017. https://www.oecd.org/env/consumption-innovation/43960846.pdf.

Bocquet, Rachel, Christian Le Bas, Caroline Mothe, and Nicolas Poussing. 2017. "CSR, innovation, and firm performance in sluggish growth contexts: A firm-level empirical analysis." *Journal of Business Ethics* 149 (1): 241–54.

Bossle, Marilia Bonzanini, Marcia Dutra de Barcellos, Luciana Marques Vieira, and Loïc Sauvée. 2016. "The drivers for adoption of eco-innovation." *Journal of Cleaner Production* 113 (2): 861–72.

Calantone, Roger J., Shawnee K. Vickery, and Cornelia Dröge. 1995. "Business performance and strategic new product development activities: An empirical investigation." *Journal of Product Innovation Management* 12 (3): 214–23.

Chen, Yu-Shan, Ching-Hsun Chang, and Feng-Shang Wu. 2012. "Origins of green innovations: The differences between proactive and reactive green innovations." *Management Decision* 50 (3): 368–98.

Cooper, Robert G., and Elko J. Kleinschmidt. 1995. "Benchmarking the firm's critical success factors in new product development." *Journal of Product Innovation Management* 12 (5): 374–91.

Cooper, Robert G., Scott J. Edgett, and Elko J. Kleinschmidt. 1999. "New product portfolio management practices and performance." *Journal of Product Innovation Management* 16 (4): 333–51.

Cooper, Robert G., Scott Edgett, and Elko J. Kleinschmidt. 2002. "Portfolio management for new product development: Results of an industry practices study." *R&D Management* 31 (4): 361–80.

Dangelico, Rosa Maria. 2016. "Green product innovation: Where we are and where we are going." *Business Strategy and the Environment* 25 (8): 560–76. https://onlinelibrary.wiley.com/doi/pdf/10.1002/bse.1886.

Dangelico, Rosa Maria, and Devashish Pujari. 2010. "Mainstreaming green product innovation: Why and how companies integrate environmental sustainability." *Journal of Business Ethics* 95 (3): 471–86.

De Marchi, Valentina. 2012. "Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms." *Research Policy* 41 (3): 614–23.

De Medeiros, Janine Fleith, José Luis Duarte Ribeiro, and Marcelo Nogueira Cortimiglia. 2014. "Success factors for environmentally sustainable product innovation: A systematic literature review." *Journal of Cleaner Production* 65 (2): 76–86.

Del Río, Pablo, Desiderio Romero-Jordán, and Cristina Peñasco. 2015. "Analysing firm-specific and type-specific determinants of eco-innovation." *Technological and Economic Development of Economy* 21 (1): 1–26.

Diedrich, Amy, Paul Upham, Les Levidow, and Sybille van den Hove. 2011. "Framing environmental sustainability challenges for research and innovation in European policy agendas." *Environmental Science & Policy* 14 (8): 935–39.

Eccles, Robert G., Ioannis Ioannou, and Georg Serafeim. 2014. "The impact of corporate sustainability on organizational processes and performance." *Management Science* 60 (11): 2835–57.

Eccles, Robert G., and Georg Serafeim. 2013. "The performance frontier." *Harvard Business Review* 91 (5): 50–60.

European Commission. 2014. "The international dimension of research and innovation cooperation addressing the grand challenges in the global context." Accessed May 19, 2017. https://ec.europa.eu/research/innovation-union/pdf/expert-groups/eriab_final_policy_brief_international_R&I_cooperation.pdf.

European Commission. 2015. "Innovation union scoreboard 2015." Accessed May 19, 2017. https://ec.europa.eu/growth/content/innovation-union-scoreboard-2015–0_en.

European Commission. 2016. "Non-financial reporting." Accessed May 19, 2017. http://ec.europa.eu/finance/company-reporting/non-financial_reporting/index_en.htm-related-information-csr.

European Commission. 2018. "Research and innovation observatory—Horizon 2020 policy support facility." Accessed July 14, 2018. https://rio.jrc.ec.europa.eu/.

EUROSTAT. 2016. "The EU in the world." Luxembourg: Publications office of the European Union. Accessed March 20, 2018. http://ec.europa.eu/eurostat/documents/3217494/7589036/KS-EX-16-001-EN-N.pdf/bcacb30c-0be9-4c2e-a06d-4b1daead493e.

Field, Andy. 2000. *Discovering statistics using SPSS for windows: Advanced techniques for beginners.* Thousand Oaks, CA: Sage.

Fraunhofer ISI. 2016. "Project: European manufacturing survey." Accessed May 19, 2017. http://www.isi.fraunhofer.de/isi-en/i/projekte/fems.php.

Gerstlberger, Wolfgang, Mette Præst Knudsen, and Ian Stampe. 2014. "Sustainable development strategies for product innovation and energy efficiency." *Business Strategy and the Environment* 23 (2): 131–14.

Gerstlberger, Wolfgang, Mette Præst Knudsen, Bernhard Dachs, and Marcus Schröter. 2016. "Closing the energy-efficiency technology gap in European firms? Innovation and adoption of energy efficiency technologies." *Journal of Engineering and Technology Management* 40 (4–6): 87–100.

Ghisetti, Claudia, and Klaus Rennings. 2014. "Environmental innovations and profitability: How does it pay to be green? An empirical analysis on the German innovation survey." *Journal of Cleaner Production* 75 (7): 106–17.

Goduscheit, René Chester, Wolfgang Gerstlberger, and Mette Præst Knudsen. 2015. "What drives innovation with an environmental impact and how does it impact product innovation performance?" In *22nd innovation and product development management conference*. Copenhagen: Copenhagen Business School.

Hart, Stuart L. 1995."A natural-resource-based view of the firm." *Academy of Management Review* 20 (4): 986–1014.

Horbach, Jens. 2008. "Determinants of environmental innovation—New evidence from German panel data sources." *Research Policy* 37 (1): 163–73.

Horbach, Jens, Christian Rammer, and Klaus Rennings. 2012. "Determinants of eco-innovations by type of environmental impact—The role of regulatory push/pull, technology push and market pull." *Ecological Economics* 78 (6): 112–22.

Hwang, Chanmi, Youngji Lee, Sonali Diddi, and Elena Karpova. 2016. "'Don't buy this jacket': Consumer reaction toward anti-consumption apparel advertisement." *Journal of Fashion Marketing and Management: An International Journal* 20 (4): 435–52.

ICF Consulting Services. 2016. "Analysis of the results achieved by CIP Eco-innovation market replication projects (EACI/ECO/2013/001)." Final Report. Brussels, ICF Consulting Services Limited. Accessed March 20, 2018. https://ec.europa.eu/easme/sites/easme-site/files/2_-_global_report.pdf.

Jovane, Francesco, Hirokazu Yoshikawa, Leo Alting, Corinne R. Boer, Engelbert Westkamper, David Williams, Mitchell M. Tseng, Günther Seliger, and Adam M. Paci. 2008. "The incoming global technological and industrial revolution towards competitive sustainable manufacturing." *CIRP Annals—Manufacturing Technology* 57 (2): 641–59.

Karvonen, Minna-Maari. 2001. "Natural versus manufactured capital: Win-lose or win-win? A case study of the Finnish pulp and paper industry." *Ecological Economics* 37 (1): 71–85.

Kemp, René, and Peter Pearson. 2007. "Final report MEI project about measuring eco-innovation (working paper)." Accessed November 10, 2017. https://www.oecd.org/env/consumption-innovation/43960830.pdf.

Kline, Stephen J., and Nathan Rosenberg. 2009. "An overview of innovation." In *Studies on Science and the Innovation Process*, 173–203. London: World Scientific Publishing.

Lampikoski, Tommi. 2012. "Green, innovative, and profitable: A case study of managerial capabilities at interface inc." *Technology Innovation Management Review.* Accessed November 10, 2017. http://www.timreview.ca/sites/default/files/article_PDF/Lampikoski_TIMReview_November2012.pdf.

Lanoie, Paul, Jérémy Laurent-Lucchetti, Nick Johnstone, and Stefan Ambec. 2011. "Environmental policy, innovation and performance: New insights on the Porter hypothesis." *Journal of Economics & Management Strategy* 20 (3): 803–42.

OECD. 2005. "The measurement of scientific and technological activities—Oslo manual". 3rd ed. Accessed March 20, 2018. http://www.oecd.org/science/inno/2367580.pdf.

Ornetzeder, Michael, and Harald Rohracher. 2006. "User-led innovations and participation processes: Lessons from sustainable energy technologies." *Energy Policy* 34 (2): 138–50.

Orr, David W. 1992. *Ecological literacy: Education and the transition to a post-modern world.* Albany: State University of New York Press.

Porter, Michael E., and Mark R. Kramer. 2011. "The big idea: Creating shared value. How to reinvent capitalism—And unleash a wave of innovation and growth." *Harvard Business Review* 89 (1–2): 62–77.

Porter, Michael E., and Claas van der Linde. 1995. "Green and competitive: Ending the stalemate." *Harvard Business Review* 73 (5): 120–34.

Præst Knudsen, Mette, and Wolfgang Gerstlberger. 2015. "Potentialer ved materialebesparelser i dansk industri: Nye Perspektiver For Ressourceeffektivitet" (in Danish, with an extended English abstract). Accessed July 17, 2018. https://groenomstilling.erhvervsstyrelsen.dk/sites/default/files/media/syddansk_hele_rapporten.pdf.

Pujari, Devashish, Gillian Wright, and Ken Peattie. 2003. "Green and competitive: Influences on environmental new product development performance." *Journal of Business Research* 56, (8): 657–71.

Ritter, Thomas, and Hans Georg Gemünden. 2004. "The impact of a company's business strategy on its technological competence, network competence and innovation success." *Journal of Business Research* 57 (5): 548–56.

Roncha, Ana, and Natascha Radclyffe-Thomas. 2016. "How TOMS' 'one day without shoes' campaign brings stakeholders together and co-creates value for the brand using Instagram as a platform." *Journal of Fashion Marketing and Management* 20 (3): 300–21.

Smith, David. 2015. *Exploring Innovation.* 3rd ed. London: McGraw Hill.

State of Green. 2016. "Denmark receives international climate award." Accessed May 19, 2017. https://stateofgreen.com/en/news/denmark-receives-international-climate-award.

Tidd, Joe, and John Bessant. 2013. *Managing innovation—Integrating technological, market and organizational change*. Chichester: Wiley.

Walley, Noah, and Bradley Whitehead. 1994. "It's not easy being green." *Harvard Business Review* 72 (3): 46–52.

Part IV

Tools, Methods and Technologies

Sustainable Innovation Tools: Two Examples from Business

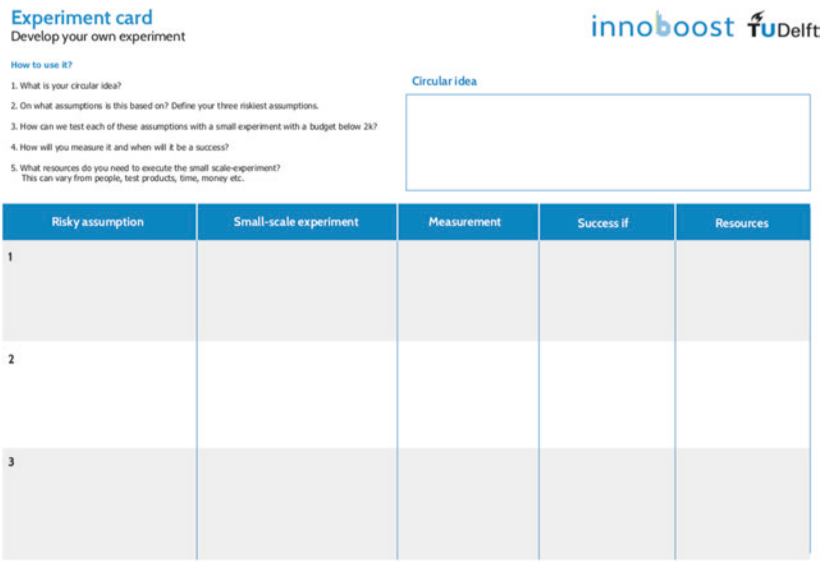
At Innoboost, a cooperative of innovation professionals we support entrepreneurs and organizations in bringing their innovative ideas to reality. We always think from a customer perspective: What do they really want and how can we surprise them with an experience? We look beyond profit. We look ahead, instead of focusing on innovations that deliver quick wins: from making a positive impact on the environment and society (or circularity), to giving them a memorable experience which makes customers love their brand even more, to cool-innovations that will engage and attract (new) employees.

We always use two 'tools' during this process:

1. The experiment card
2. The Value Customer Experience template

These and other tools, based on action research in collaboration with researchers from Delft University of Technology (TU Delft), are available at: www.innoboost.nl/tools

The experiment card: The goal of the experiment card is to capture facts and assumptions—the starting point for small and quick learning experiments. It is an efficient and easy-to-use tool for front-end innovation teams to capture key risks and assumptions during an innovation process, best used in the early phase of innovation, before significant financial and resource investments are done in product/service development. At the beginning of the conversation with our customers, we want to understand what the scope is, the 'why, what and how' of their circular innovation(s). Most innovation teams have to deal with assumptions in the front-end of the innovation phase. The experiment card captures these assumptions during the innovation process. The key or most risky assumptions that could have a big impact on bringing the innovation idea to market are the starting point to identify and design the experiment(s). The first step is to agree what we will measure in the experiment. The next step is to set the criteria for success. After execution of the experiment, the team will reflect and learn from the outcomes and further develop and improve the innovative ideas. The assumption card should be updated with new assumptions. These learning cycles are repeated until the team has reduced the list with assumptions to a level that the team and project sponsor decide to start with the development of a product/service and market introduction.


Experiment card
Develop your own experiment

innoboost TUDelft

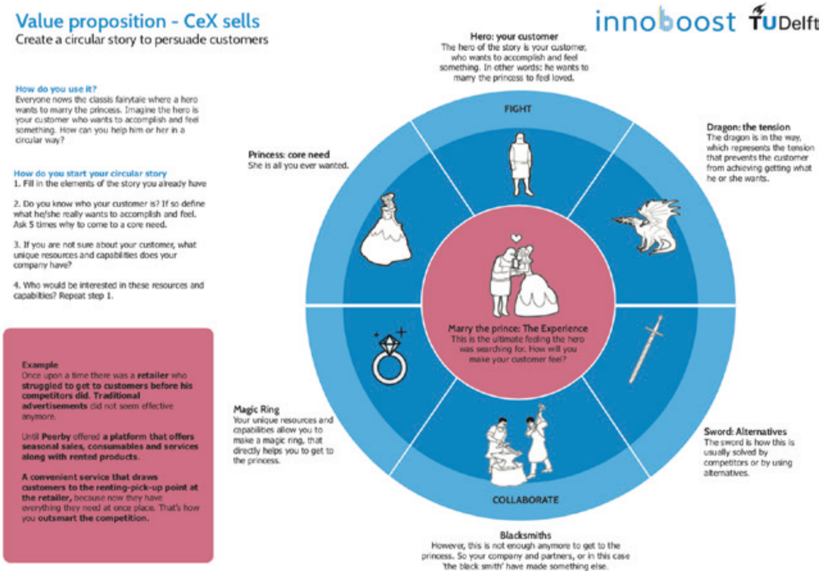
How to use it?

1. What is your circular idea?
2. On what assumptions is this based on? Define your three riskiest assumptions.
3. How can we test each of these assumptions with a small experiment with a budget below 2k?
4. How will you measure it and when will it be a success?
5. What resources do you need to execute the small scale-experiment?
This can vary from people, test products, time, money etc.

Circular idea

Risky assumption	Small-scale experiment	Measurement	Success if	Resources
1				
2				
3				

The Value Customer Experience template: The goal of the CeX-template is to create a circular story to persuade customers. It's a circular and inspiring alternative for the value proposition templates based on the idea of a fairy tale. The story begins with the Hero, your customer. The Hero of the story is your customer, who wants to accomplish and feel something. In other words: he/she wants to marry the Princess to feel loved. The Princess: she is all you ever wanted and she expresses the core need(s) you have to fulfil. However, the Dragon is in the way, which represents the tension that prevents the customer from achieving getting what he or she wants. The Hero can have a Sword to beat the Dragon. The Sword symbolises how this is usually solved by your competitors or by your customers using alternatives. You will need the Blacksmiths because the Sword is not sufficient anymore to get to the Princess. So, your company and partners, or in this case the 'Black smith', have made something else. Your unique resources and capabilities allow you to make a Magic Ring that directly helps you to get to the Princess. Finally, you will marry the Princess: the Experience. This is the ultimate feeling the Hero was searching for and is about how your product/service offering will make your customer feel.



Christiaan Kraaijenhagen, Entrepreneur, innovation strategist & partner at Innoboost

18

Experimentation for Sustainable Innovation

Ilka Weissbrod

Introduction

Current production and consumption patterns will not support the creation of social, environmental and economic ('triple bottom line') value in the longer term (Tennant 2013; Schaltegger et al. 2016). A linear view of economics and the accompanying 'business as usual' paradigm will result in incremental innovation (Dewberry and de Barros 2009); such incremental innovation is unlikely to solve urgent climate and resource challenges (Dewberry and de Barros 2009; Westley et al. 2011). Business value offerings have to radically change: 'do differently' is needed rather than 'do what we do but better' (Bessant et al. 2014). Do differently innovation is

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full of unknowns and requires experimentation in the corporate innovation process (Chang et al. 2012). This chapter explores how experimentation can provide evidence to support the development of triple bottom line product and services in businesses or how experimentation can support sustainable innovation.[1] Previous research has made the link between the lean startup approach, triple bottom line value creation and experimentation as corporate innovation capability (Weissbrod and Bocken 2017). This chapter adds to the research on experimentation for sustainability through (1) contrasting experimentation in the natural sciences with experimentation during sustainable innovation and (2) insight on how a large corporation (Procter & Gamble) experiments during the sustainable innovation process. The chapter narrows down triple bottom line value creation to the life extension of resources. The reason for this is twofold: firstly, it enables readers to engage with the method easily because the triple bottom line value creation goal of business innovation activities is defined. Secondly, the focus on extending the life of resources enables readers to make the link between the increasingly popular sustainability concept Circular Economy and the sustainable innovation method of experimentation. Extending the life of resources lies at the heart of the Circular Economy concept (Blomsma and Brennan 2017).

The chapter starts with theory on experimentation (sections "Experimentation as a Learning Method" and "Fast Learning Cycles based on the Lean Startup Approach"), goes on to contextualise the theory with some practitioner insight (sections "The Case of Procter & Gamble" and "Familiar Innovation Mechanisms open the door for Sustainable Innovation") and finishes with offering a method (section "Customer Development Cycles to Test Sustainable Innovation Ideas") and conclusions.

Experimentation as a Learning Method

Experimentation, in essence, is 'a trial and error process in which each trial generates new insights on a problem' (Lee et al. 2004: 310) and this process 'relies primarily on an intervention and that allows for the production of empirical evidence' (Caniglia et al. 2017). Empirical evidence is key to the scientific process (Caniglia et al. 2017; Hicks 1982). Academic researchers have set experimentation as driver of societal transitions in the context of sustainability challenges (Caniglia et al. 2017; Luederitz et al. 2017; Weber et al. 1999), as approach to generate new business models (Andries et al. 2013; Antikainen et al. 2017; Bocken et al. 2018; Chesbrough 2010; Tuulenmäki and Välikangas 2011) and studied it as an organisational capability for sustainable innovation processes (Weissbrod and Bocken 2017). All of these research strands have in common that organisations and society acknowledge that action-led learning is useful to support the development of theory that is relevant to practitioners in business and society.

Experimentation in the natural sciences aims to produce evidence that is universally applicable, value-free and disconnected from context (Mitchell 2009). Experiments are strictly controlled: replicability of experiments and applying deductive learning only are two principles unique to the natural sciences. Some principles of experimental learning, however, are universally relevant. An example is articulating the problem to be addressed or, in other words, the hypothesis to be tested. The planning of experiments helps to define and narrow down this problem to be investigated in a process or system: 'A careful statement of the problem goes a long way toward its solution' (Hicks 1982: 3). The person conducting the experiment, the 'experimenter', starts by asking questions about the problem/hypothesis in order to plan experimental designs. This will, ideally, lead to useful answers through the smallest number of tests (Atkinson and Donev 1992) through focusing on the most critical of hypotheses (Osterwalder et al. 2014). Another example of a universally relevant experimental learning principle is that restricting the number of experiments is desired to enable maximum learning through efficient use of resources: time and money. This principle has also been identified as characteristic of sustainable business model experimentation in recent research (Bocken et al. 2018). The final articulation of the problem/hypothesis addressed through the experiment should include a reference to one or multiple experimentation assessment criterion (Hicks 1982). This will ensure that relevant evidence is generated.

In an ideal natural sciences experimental setting, the experimenter will manipulate inputs into an experiment and the differences between experiment input and output will help to gain the desired learning (Fig. 18.1).

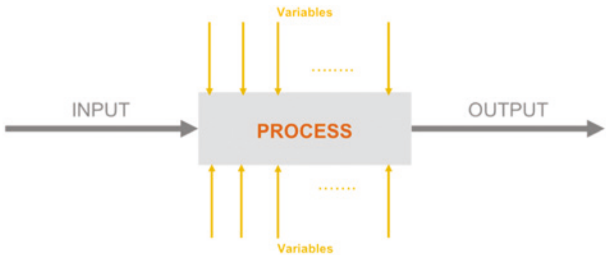

Fig. 18.1 General model of a process under investigation (Adapted from Montgomery 2001)

Variables in natural sciences experiments are the key to gaining cause-and-effect insights: there are three types. (1) Independent variables are what the experimenter manipulates during an experiment. These manipulations impact the (2) dependent variables and lead to the difference between input and output. The (3) controlled variables are process or system factors that the experimenter needs to keep stable. Only with stable controlled variables can the effects of manipulating the independent variable(s) on the dependent variable(s) be observed.

During sustainable innovation processes, however, applying the natural sciences experimental learning process is nearly impossible. For once, sustainability has been described as a 'moving target' (Gaziulusoy et al. 2013: 105), therefore, replicability of experiments is difficult. Even with a defined goal of extending the life of resources used in products and services through innovation activities, the process or system to be investigated through experimentation will change. Uncontrollable are the experiment input (e.g. new data about resource use needs to be considered, the innovation team resources change) and the experiment variables (e.g. customers bring with them different expectations and life experiences and might, therefore, be viewed as an uncontrollable variable). Furthermore, the linear natural sciences experimentation process omits the 'messy' nature of social interactions and dynamics that are present (Mitchell 2009), and even necessary, in business learning processes that underpin the development of new products (Lenox and Ehrenfeld 1998). Finally, innovation for sustainability has a higher number of elements compared to conventional innovation (Jay and Gerard 2015); therefore, the sustainable innovation process has a higher level of complexity[2] (Maguire et al. 2006). This means that the unknowns to be explored through experiments in sustainable innovation are higher in number than during conventional innovation. All this poses a dilemma for innovation managers in business looking to increase the triple bottom line value 'output' of their innovation process.

Fast Learning Cycles based on the Lean Startup Approach

In contrast to the linear scientific experimental learning process (Fig. 18.1), circular learning loops are a means for innovation managers to generate evidence in the business context. This chapter section explains the origins of this learning approach and sets it in the context of sustainable innovation.

At the heart of innovation lays the novel combination of production means (Schumpeter 1934). Entrepreneurs drive these novel combinations and sometimes even destroy stagnant markets through these activities. Since Schumpeter, how to engage customers in the creation of new services has become a distinct field of management research (Edvardsson et al. 2006; Füller and Matzler 2007). New products and services should be based on gaps in the markets or they should solve customer problems. Filling these gaps and addressing these problems with new customer value offerings should be pursued whilst engaging customers (Blank 2013; Edvardsson et al. 2006; Ries 2011). 'Customer development' (Blank 2013), also known as 'validated customer proposition learning' (Ries 2011), is a proven method to generate insights about customers (Müller and Thoring 2012) and has gained substantial traction in the startup world and now also in larger corporations (Blank 2013). This learning approach, coupled with principles from the agile engineering software development process, lies at the heart of the 'lean startup' approach, the term coined by Eric Ries (2011). In essence, validated customer proposition learning is looking to increase customer benefits through fast product and service iterations (Blank 2013; Ries 2011). Ideas are built up into minimum viable products (MVPs), customer reaction to these products/services is measured and the resulting data contain the key learning needed to refine the product/service idea (Fig. 18.2). The MVPs used in this process need to be refined enough to enable the completion of the full learning cycle, at the same time these product versions are created with 'a minimum amount of effort and the least amount of development time' (Ries 2011: 77).

This learning cycle about how customers react to MVPs is repeated fast and, usually, more than once (Blank 2013; Ries 2011). Only when customers respond well to the minimum viable product, marketing of the new products/services and building of a business model should take place (Blank 2013; Bocken et al. 2018). Intensive customer engagement during, ideally quick, product and service iterations will enable innovators to achieve product/service fit with gaps in the market. Both established businesses and small startups may pursue sustainable innovation (Hockerts and Wüstenhagen 2010). It has been observed that

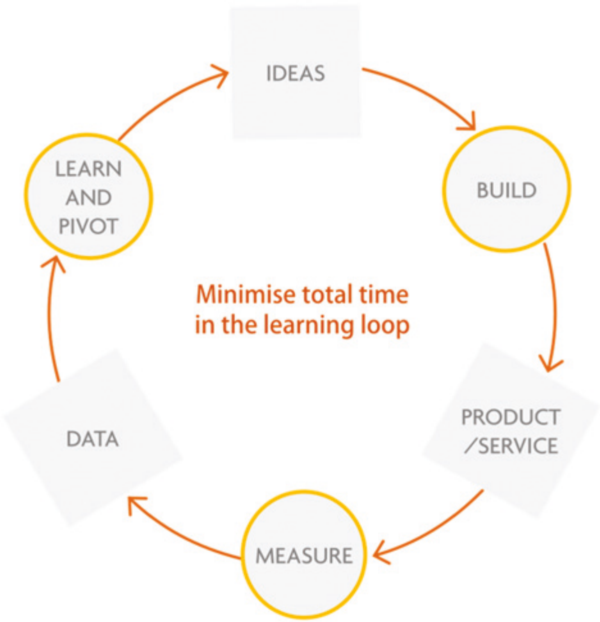

Fig. 18.2 Validated customer learning loop (Amended from Weissbrod and Bocken 2017, adapted from Ries 2011 and Blank 2013)

resource-rich large firms are more likely than cash-strapped startups to overcommit resources to launch a new value offering to the market. Even for successful large firms, without sufficiently testing whether customers have an appetite for the new offering, this overcommitting of resources can be 'catastrophic' (Blank 2013: 11) for survival.

The work by Osterwalder et al. (2014) brought together the customer development work by Blank (2013), Ries (2011) and the business model canvas developed by Osterwalder and Pigneur (2009). The 'pure' customer development approach (i.e. Blank 2013; Ries 2011), however, is starting with producing new value propositions from scratch. In contrast, Osterwalder et al. (2014) anchor their customer development tool ('Value Proposition Canvas') in the business model canvas, i.e. the business structure: 'the Value Proposition Canvas zooms into the details of two building blocks of the business model canvas' (p. XIV). This book chapter argues that this structural starting point means a more likely re-enforcement of the business status quo (i.e. incremental innovation), because organisational structures known to the person populating the canvas with its nine building blocks (Osterwalder et al. 2014; Osterwalder and Pigneur 2009) are considered during the customer development process. This is especially disadvantageous if the person populating the canvas has a business school background: it has been observed that they 'want only to execute a pre-designed business model, based on standard principles about sales, marketing and customer reaction, which they regard as facts' (Blank 2011). Sustainable innovation requires new ways of thinking and will result in the creation of new, more sustainable, business models (Boons and Lüdeke-Freund 2013). Using the customer development approach proposed by Blank (2013) and Ries (2011) might help to facilitate the necessary new ways of thinking, because this approach does not start with the business structure as starting point for sustainable innovation. Instead, testing triple bottom line value creation ideas with customers is the starting point. It has been argued in classic eco-innovation literature that businesses should aim to create new markets—and not focus on current customer demand (Fussler and James 1996). The creation of new markets requires, however, a change in current customer demand. Therefore, the testing of triple bottom line value creation ideas with customers for their market potential, before broadening sustainable innovation efforts to the wider business model, has been recommended (Bocken et al. 2018).

The Case of Procter & Gamble

A semi-structured interview with the P&G Vice President of Global Sustainability, Virginie Helias, explored how the business experiments to innovate for sustainability. Multinational business P&G specialised in selling fast moving consumer goods in the home and personal care sector. Within this sector, the largest share of sustainability product impacts takes place in the home of the customer. For example, shower gel and laundry detergents are most resource intensive after the customer bought them: water is the most impacted resource. Carbon emissions are also highest in this stage of the product value chain, due to the energy needed to heat water. P&G achieved significant resource efficiency achievements over the last 10 years within its direct operations: in 2017, 65% of manufacturing sites sent zero waste to landfill, with a goal of 100% by the year 2020. In order to achieve equal success once P&G products reach the customer, the business recognises that efficiency gains alone will not suffice. P&G has a history for successful innovation approaches and sustainability management. Academic research has, therefore, used P&G as example of how a corporation uses the open innovation approach (e.g. Dodgson et al. 2006), with the sustainability management approach also explored in research (e.g. Epstein et al. 2010). The interview was conducted at the P&G premises, recorded and verbatim transcribed, with publicly available information supplementing the original interview data.

Familiar Innovation Mechanisms open the door for Sustainable Innovation

This section presents key challenges a business might encounter during the sustainable innovation process and how these challenges are acknowledged and potentially addressed. The case of P&G is drawn upon throughout.

If a business is looking to increase sustainable innovation efforts after mainly pursuing conventional innovation, generating social and environmental value through innovation activities will be unfamiliar to the business. The lean startup learning cycle can be a useful means to generate targeted learning through customer experiments, whilst dealing with the unfamiliarity of creating social and environmental value (Weissbrod and Bocken 2017). Unfamiliarity with environmental and social value creation can be expected in teams that are usually in pursuit of conventional innovation. For example, water usage during personal care is a key sustainability impact that is relevant to P&G. The teams developing new shampoo formulation might not, however, consider this sustainability impact from the outset of the innovation process and sustainable innovation might even happen by accident.

> Very often people working on innovation develop sustainable innovation without knowing it.

Embedding sustainability knowledge across all teams pursuing innovation will, therefore, be beneficial for the recognition of sustainable innovation opportunities. This will enable wider rollout of sustainable innovation in the business divisions that develop new products and services. P&G's Vice President Global Sustainability sees her role explicitly in the embedding sustainability in the ongoing business practice:

> We have a group of people on sustainability who are corporate and I'm not corporate. I'm really embedded in the business because my vision is to embed sustainability into the business practices and culture. (..) I work with the business to help them accelerate their innovation, their commercialisation and their capabilities to drive sustainability into the heart of the business.

Focusing on exploring gaps in the markets allows teams in pursuit of sustainable innovation to test a variety of triple bottom line value creation opportunities. At the same time, mirroring the existing dominant corporate approach to conventional innovation can be helpful to push for sustainable innovation within a business—this can enable faster progress to achieve new, stretching, triple bottom line value creation goals. In the case of P&G, open innovation is embedded throughout the company and sustainable innovation does capitalise on the success this approach brought to the business. It is one way in which ideas for sustainable innovation come into the business.

> The [P&G open innovation] Connect and Develop concept applies to all innovation including sustainability. I think what we see on sustainability is that we are getting lots of ideas from our suppliers coming to us with sustainability ideas because they are just working on this. The key challenge really is (..) to bring them to the right people in the business because it's just unfamiliar territory. That would be the difference with other innovation ideas, is that people are not really familiar with what [sustainable innovation] is and what it can do and have lots of preconceived ideas of, "It will always be more expensive". One of my roles is to make sure that I see these ideas and I bring them to the right place in the business and we can nurture them and then develop them internally.

The key challenge of developing ideas internally is a dilemma not only for P&G. Research on pursuing innovation outside the business status quo has been trying to untangle the key barriers and components for many years. One of the key barriers identified is a restrictive mindset and a lack of relevant competences to pursue activities outside the innovation status quo (Sandberg and Aarikka-Stenroos 2014). P&G identified the lack of sustainability competences as an area for ongoing improvement during the pursuit of sustainable innovation. Allowing experiments that are outside the known corporate innovation mechanisms to flourish internally is highly dependent on the leader of a division. P&G is no exception: a product division leader with a deep understanding of sustainability and an appetite for experimenting to develop different and more sustainable products has been essential to allow experimentation with triple bottom line value propositions. In the division, the innovation team took part in a highly unusual off-site excursion. The goal of the excursion was to experience how P&G products impact social and environmental sustainability. The team went to Kenya.

> So that's the most extreme of inspiration. It's taking a full week away in Kenya. I wanted to show them how their technology could actually have a

> lot greater impact that what we can imagine, social and environmental. It was an absolutely fabulous experience. We brought back four big business ideas. Three of them are now [Author note: 2014] being implemented, so very successful. (..) One is in pilot, one is integrated into our innovation pipeline and the other two actually are just integrated in the innovation pipeline, so they are being worked as part of the full traditional innovation system.

The innovation goal for the excursion team taken to Kenya was fairly broad in its scope to explore social and environmental value creation. For the purposes of this particular excursion, a broad goal was useful. For more targeted experiments, during the innovation process this is, however, different. It has long been established that clear measurable goals of project activities 'help to absorb uncertainty and create focus' (McGrath 2001: 120). Uncertainty is related to a high level of complexity and as argued earlier, sustainable innovation is more complex than conventional innovation due to the higher number of factors involved (Jay and Gerard 2015). After all, how can we design an experiment and gain useful learning if we do not know what we are trying to achieve with the experiment (see Hicks 1982)? Making better use of resources used in products and services (i.e. extending the life of resources) is a clearly defined goal for innovation activities. P&G does not only use long excursions for innovation teams to gain a deeper understanding of sustainability challenges. Visiting a landfill to highlight the undesirability of a linear consumption pattern has been an excursion destination that took place over much shorter period of time. The goal of reducing post-consumer waste going to landfill was the driver for the landfill site-visit of the P&G innovation team and aligned with the operational goal of reducing waste going to landfill to zero by 2020 for all P&G manufacturing facilities.

Customer Development Cycles to Test Sustainable Innovation Ideas

Open innovation or site visits are two possible ways in which businesses can generate new product and service ideas. Turning these sustainable innovation ideas into commercial offerings is where the customer development cycle (Blank 2013; Ries 2011) comes into play. The key difference between using the customer cycle in conventional innovation activities and sustainable innovation activities is twofold. Firstly, the learning goal to be served with using the customer development cycle must aim to serve social, environmental and economic value creation in equal measure. Secondly, triple bottom line value creation knowledge must be embedded in the team that experiments to ensure deliberate rather than accidental learning. Customer development cycles test different versions of MVPs, with a number of cycles running in parallel. Each customer development cycle consists of the 6 steps outlined earlier (Fig. 18.2). To recall: (1) ideas are (2) built up into (3) MVPs, consumer responses to these are (4) tested and measured, and this (5) data is used to (6) refine the ideas. For the purpose of sustainable innovation, each customer development cycle should be underpinned by triple bottom line value creation. At the same time, the business has social, environmental and economic value creation priorities at the corporate level that innovations must meet. In the case of P&G, the goal of 'zero waste to landfill from manufacturing sites' is a key value creation priority. Corporate triple bottom line value creation priorities form the boundaries of the experimentation space for the customer development cycles. A combination of (1) the articulated sustainable innovation goal and (2) the triple bottom line boundaries created by the corporate priorities enable innovation teams to focus, whilst they explore new products and services through customer testing. Figure 18.3 shows how product and service ideas that look to extend the lifetime of resources can be tested through customer development cycles. Social (purple), environmental (green) and economic (blue) value creation underpin each customer development cycle. At the same time, the boundary for the total experimentation space (orange line), broadens out in scope before narrowing again. This is to be expected due to the moving sustainability goalposts (Gaziulusoy et al. 2013) and the large number of interconnected factors in sustainable innovation (Jay and Gerard 2015) that increase uncertainty. Previous case study research has observed the broadening of the triple bottom line boundary scope: it allowed for the customer exploration of value propositions outside the current business practice (Weissbrod and Bocken 2017).

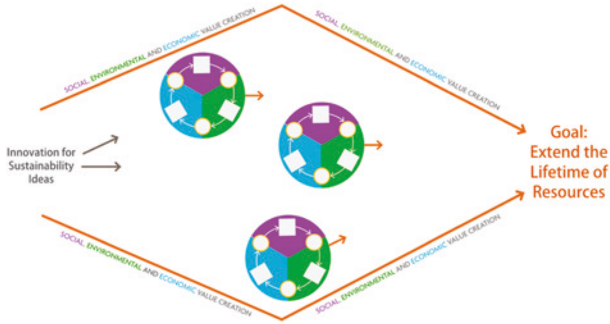

Fig. 18.3 Experimental learning method for sustainable innovation based on the lean startup approach (Adapted from Weissbrod and Bocken 2017)

Extending the lifetime of resources, key to the concept of the Circular Economy, is the problem that the experimentation process shown in Fig. 18.3 addresses. There is no single triple bottom line experimentation boundary that is universally applicable across all industries and companies. Each sustainable innovation experimentation process aimed at refining sustainability ideas is a real balancing act. Here is P&G's take on this sustainable innovation balancing act:

> There is a lot of education linked to this, because (..) What is more sustainable? So you need to touch on things like LCA [Life Cycle Assessment] - if you improve on one dimension [of sustainability], you need to make sure you don't worsen on the other dimensions. So it's a very complex topic.

Indeed, research has found that experimental learning approaches are hard to implement in businesses, included in businesses dedicated to innovation and even business model experimentation (Tuulenmäki and Välikangas 2011). It is, however, a necessary step to pursue the development of triple bottom line products and services. Without customer development experiments to test MVPs, there is a risk of developing full-scale pilots that will have no traction in the marketplace (Blank 2011).

Conclusions

This chapter showed the differences in the theoretical underpinning between experimentation for sustainable innovation and the natural sciences experimentation process. In contrast to the linear experimentation process used in natural sciences, experimentation for sustainable innovation is a cyclical process during which experimentation variables cannot be tightly controlled. The case of P&G highlighted some of circumstances a business might encounter when looking to experiment during the sustainable innovation process. Sustainable innovation is more complex than conventional innovation due to the higher number of factors involved. The experimenting business can, therefore, expect for the problem space to change and even broaden out during the experimentation process. In addition, balancing the three aspects of triple bottom line value creation is hard for businesses to achieve. Practitioners looking to develop sustainable business models should initially run experiments to test a new triple bottom line value creation with potential customers. This will ensure that broader business model experiments, likely to include a larger number of stakeholders, are building on a strong triple bottom line value creation foundation. Future research needs to test and develop the method shown in Fig. 18.3 through case studies. Ideally, the case study businesses aim to explicitly experiment during the sustainable innovation process, in order to achieve challenging triple bottom line value creation goals.

Notes

1. Sustainable innovation is used throughout this chapter as term to encompass corporate innovation activities that aim to produce triple bottom line product and service offers.
2. This assertion is based on 'Features of complex systems' as presented by Maguire et al. (2006: 166); the authors do not refer specifically to features of innovation processes.

References

Andries, Petra, Koenraad Debackere, and Bart Van Looy. 2013. "Simultaneous experimentation as a learning strategy: Business model development under uncertainty." *Strategic Entrepreneurship Journal* 7 (4): 288–310.

Antikainen, Maria, Anna Aminoff, Harri Paloheimo, and Outi Kettunen. 2017. "Designing circular business model experimentation—Case study." In *The Proceedings of the 2017 ISPIM Forum*, 19–22, Toronto, Canada.

Atkinson, Anthony C., and Alexander N. Donev. 1992. *Optimum experimental designs*. Oxford, UK: Clarendon Press.

Bessant, John, Christina Öberg, and Anna Trifilova. 2014. "Framing problems in radical innovation." *Industrial Marketing Management* 43 (8): 1284–92.

Blank, Steve. 2011. "Embrace failure to start up success." *Nature News* 477 (7363): 133.

Blank, Steve. 2013. (1st Edition 2005). *The four steps to the epiphany: Successful strategies for products that win*, 5th ed. San Francisco, USA: K&S Ranch Publishing.

Blomsma, Fenna, and Geraldine Brennan. 2017. "The emergence of circular economy: A new framing around prolonging resource productivity." *Journal of Industrial Ecology* 21 (3): 603–14.

Bocken, Nancy M. P., Cheyenne S. C. Schuit, and Christiaan Kraaijenhagen. 2018. "Experimenting with a circular business model: Lessons from eight cases." *Environmental Innovation and Societal Transitions* 28: 79–95.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Caniglia, Guido, Niko Schäpke, Daniel J. Lang, David J. Abson, Christopher Luederitz, Arnim Wiek, Manfred D. Laubichler, Fabienne Gralla, and Henrik von Wehrden. 2017. "Experiments and evidence in sustainability science: A typology." *Journal of Cleaner Production* 169: 39–47.

Chang, Yuan-Chieh, Huo-Tsan Chang, Hui-Ru Chi, Ming-Huei Chen, and Li-Ling Deng. 2012. "How do established firms improve radical innovation performance? The organizational capabilities view." *Technovation* 32 (7–8): 441–51.

Chesbrough, Henry. 2010. "Business model innovation: Opportunities and barriers." *Long Range Planning* 43 (2–3): 354–63.

Dewberry, Emma L., and Margarida Monteiro de Barros. 2009. "Exploring the need for more radical sustainable innovation: What does it look like and why?" *International Journal of Sustainable Engineering* 2 (1): 28–39.

Dodgson, Mark, David Gann, and Ammon Salter. 2006. "The role of technology in the shift towards open innovation: The case of Procter & Gamble." *R&D Management* 36 (3): 333–46.

Edvardsson, Bo, Anders Gustafsson, Per Kristensson, Peter Magnusson, and Jonas Matthing. 2006. *Involving customers in new service development*. London, UK: Imperial College Press.

Epstein, Marc J., Adriana Rejc Buhovac, and Kristi Yuthas. 2010. "Implementing sustainability: The role of leadership and organizational culture." *Strategic Finance* 91 (10): 41.

Fussler, Claude, and Peter James. 1996. *Driving eco-innovation: A breakthrough discipline for innovation and sustainability.* London, UK: Pitman Publishing.

Füller, Johann, and Kurt Matzler. 2007. "Virtual product experience and customer participation—A chance for customer-centred, really new products." *Technovation* 27 (6–7): 378–87.

Gaziulusoy, İdil, Carol Boyle, and Ron McDowall. 2013. "System innovation for sustainability: A systemic double-flow scenario method for companies." *Journal of Cleaner Production* 45: 104–16.

Hicks, Charles. 1982. *Fundamental concepts in the design of experiments.* New York, US: CBS College Publishing.

Hockerts, Kai, and Rolf Wüstenhagen. 2010. "Greening Goliaths versus emerging Davids—Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship." *Journal of Business Venturing* 25 (5): 481–92.

Jay, Jason, and Marine Gerard. 2015. "Accelerating the theory and practice of sustainability-oriented innovation." MIT Sloan Research Paper No. 5148-15. Available at SSRN: http://dx.doi.org/10.2139/ssrn.2629683.

Lee, Fiona, Amy C. Edmondson, Stefan Thomke, and Monica Worline. 2004. "The mixed effects of inconsistency on experimentation in organizations." *Organization Science* 15 (3): 310–26.

Lenox, Michael, and John Ehrenfeld. 1998. "Organizing for effective environmental design." *Business Strategy and the Environment* 6 (4): 187–96.

Luederitz, Christopher, Niko Schäpke, Arnim Wiek, Daniel J. Lang, Matthias Bergmann, Joanette J. Bos, Sarah Burch, Anna Davies, James Evans, Ariane König, Megan A. Farrelly, Nigel Forrest, Niki Frantzeskaki, Robert B. Gibson, Braden Kay, Derk Loorbach, Kes McCormick, Oliver Parodi, Felix Rauschmayer, Uwe Schneidewind, Michael Stauffacher, Franziska Stelzer, Gregory Trencher, Johannes Venjakob, Philip J. Vergragt, Henrik von Wehrden, and Frances R. Westley. 2017. "Learning through evaluation—A tentative evaluative scheme for sustainability transition experiments." *Journal of Cleaner Production* 169 (4): 61–76.

Maguire, Steve, Bill McKelvey, Laurent Mirabeau, and Nail Öztas. 2006. "Complexity science and organization studies." In *The Sage handbook of organization studies*, edited by Stewart Clegg, Cynthia Hardy, Tom Lawrence, and Walter Nord, 165–214. London, UK: Sage.

McGrath, Rita Gunther. 2001. "Exploratory learning, innovative capacity, and managerial oversight." *Academy of Management Journal* 44 (1): 118–31.

Mitchell, Sandra D. 2009. *Unsimple truths: Science, complexity, and policy*. Chicago, USA: University of Chicago Press.

Montgomery, Douglas. 2001. *Design and analysis of experiments*, 5th ed. New York, USA: Wiley.

Müller, Roland M., and Katja Thoring. 2012. "Design thinking vs. lean startup: A comparison of two user-driven innovation strategies." In *Leading through design. International Design Management Research Conference*, August 8–9. Boston, USA.

Osterwalder, Alex, and Yves Pigneur. 2009. *Business model generation.* Amsterdam, The Netherlands: Modderman Drukwerk.

Osterwalder, Alex, Yves Pigneur, Greg Bernada, and Alan Smith. 2014. *Value design proposition. How to create products and services customers want*. Hoboken, USA: Wiley.

Ries, Eric. 2011. *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses.* London, UK: Penguin Books.

Sandberg, Birgitta, and Leena Aarikka-Stenroos. 2014. "What makes it so difficult? A systematic review on barriers to radical innovation." *Industrial Marketing Management* 43 (8): 1293–1305.

Schaltegger, Stefan, Florian Lüdeke-Freund, and Erik G. Hansen. 2016. "Business models for sustainability: A co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation." *Organization & Environment* 29 (3): 264–89.

Schumpeter, Joseph A. 1934. *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge, USA: Harvard University Press.

Tennant, Mike. 2013. "Sustainability and manufacturing." In *The future of manufacturing: A new era of opportunity and challenge for the UK*. London: Government Office for Science and Department of Businesses.

Tuulenmäki, Anssi, and Liisa Välikangas. 2011. "The art of rapid, hands-on execution innovation." *Strategy & Leadership* 39 (2): 28–35.

Weber, Matthias, Remco Hoogma, Ben Lane, and Johan Schot. 1999. *Experimenting for sustainable transport innovations. A workbook for Strategic Niche Management*. Seville, Spain: Institute for Prospective Technological Studies.

Weissbrod, Ilka, and Nancy M. P. Bocken. 2017. "Developing sustainable business experimentation capability—A case study." *Journal of Cleaner Production* 142: 2663–76.

Westley, Frances, Per Olsson, Carl Folke, Thomas Homer-Dixon, Harrie Vredenburg, Derk Loorbach, John Thompson, Måns Nilsson, Eric Lambin, Jan Sendzimir, Banny Banerjee, Victor Galaz, and Sander Leeuw. 2011. "Tipping toward sustainability: Emerging pathways of transformation." *Ambio* 40 (7): 762–80.

19

Experimenting with Circular Business Models—A Process-Oriented Approach

Maria Antikainen and Nancy Bocken

Introduction

It is widely accepted that we need to move towards a more sustainable and preserving economic model (Seiffert and Loch 2005; Ellen MacArthur Foundation 2013; Markard et al. 2012). The circular economy (CE) is currently offered as a key solution for creating a regenerative and restorative economic model (Geissdoerfer et al. 2017). The idea is based on resource sufficiency and sustaining the value of materials with business and technological innovations (Ellen MacArthur Foundation 2013). To move towards the CE, a systemic innovation in

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all aspects of society is needed, including values and consuming practices, as well as technological and business innovations throughout societal structures (Wells 2013; Ellen MacArthur Foundation 2013). Currently, we know that we are overusing the globe's capacity dramatically; therefore, we need to change our system radically and at a rapid pace (WWF 2016). Thus, we need to find solutions to accelerate the innovation processes towards circular business models.

The CE will be based on novel ecosystems, where resource loops are closed jointly with other companies. Value is also divided and evaluated in novel ways. For example, growing amounts of clothing retailers have started to collect used clothing to recycle this in collaboration with recycling companies and NGOs (e.g. H&M and SUEZ, and M&S and Oxfam collaborations). Thus, companies need to find new collaboration partners as well as consider the value proposition, creation and capture in a novel way to redesign their business models for the CE (Bocken et al. 2013; Kraaijenhagen et al. 2016). Since the CE changes the value creation logic in business models and requires radical innovation, the existing business model innovation tools and methods need updating and new ones need to be innovated to facilitate this process (Antikainen and Valkokari 2016; Boons et al. 2013; Bocken et al. 2018).

One promising approach for circular business model innovation is circular business model experimentation (Weissbrod and Bocken 2017), which centres around trialling new business options in a low-cost and low-resource manner (Thomke 2003; Antikainen et al. 2017; Weissbrod and Bocken 2017). During the last years, companies and other organisations have started to increasingly utilise business model experimentations as a part of their business model innovation processes (e.g. Tuulenmäki and Välikangas 2011). Also, at a national level, the importance of business model experimentations and piloting have been highlighted (Hoogma et al. 2005) and increasingly supported by different funding sources. Perhaps the most important benefit is gained by the fact that business model experimentation provides data or evidence based on a tested 'model', instead of hypothetical assumptions (Tuulenmäki and Välikangas 2011). Business model experimentations also help to understand the acceptability of the model among stakeholders, especially consumers (Ries 2011; Blank 2013), which is valuable in the innovation of circular business models that often require novel practices from consumers. Moreover, experimentations are valuable when innovating a circular business model since they can provide knowledge on potential collaborations and help to facilitate a mindset change. Moreover, they can help drive internal transformations towards a CE by gathering real tangible evidence about new propositions (Bocken et al. 2017, 2018).

Despite the promised benefits, the development of the circular business model experimentation approach is still in its infancy and there is no single process or definition. The few existing tools have mostly focused on quantitative perspective such as measuring the number of users of the tested business model (e.g. A/B split testing that tracks how many people click on advertisement A or B, as suggested e.g. by Ries 2011; Osterwalder et al. 2014). Still, concerning the novelty of the tested ideas in experimentations, a more explorative approach using qualitative methods is often needed.

This considered, in this chapter, our aim is twofold. Firstly, we illustrate how a process model approach can be used in designing and implementing a business model experimentation. Secondly, we identify the main challenges of business model experimentation in different phases. The process-based approach is valuable as it offers a practical tool for companies and other organisations involved (e.g. research organisations) for the design and implementation as well as it helps to divide different stages in the separate elements helping to analyse the challenges and benefits, for instance. As empirical data, we draw on data from a case study company called Liiteri, from which the data are collected with multiple methods (interviews and informal discussions; see Antikainen and Valkokari 2016).

The remainder of the chapter is organised as follows. First, we present a definition of a circular business model experimentation and discuss why this is needed. Then, we present a process-oriented approach to circular business models by combining previous literature. After that, we present our case study, a tool renting service pilot called Liiteri highlighting the identified challenges and benefits identified in the different process steps. Finally, we discuss the results and present the contributions.

Circular Business Model Experimentations (CBME) and Why They Are Needed

Definition of CBME

Experimentation as a method and concept is not new, but it has been commonly used in natural sciences (Bocken et al. 2016; De Vaus 2001). Usually, experimentation is used to test existing theories or new hypotheses in order to support or disprove them. In the social science context, implementing experiments is rather challenging because of the difficulties associated with controlling the variables (De Vaus 2001).

In the business model context, 'experimentation' is often used to refer to the method that aims to set up experiments and to control and manipulate certain variables of the business model. The aim is that through rapid experimentations a hypothesised outcome is tested through empirical observations of data, such as usage data or market share (Brunswicker et al. 2013).

In addition to the usage of the term experimentation, other related terms are used. 'Prototyping' is often used to highlight the importance of iterative learning and problem-solving processes in (business model) innovation. This is similar to the term 'experimentation' which refers to a process of testing different solutions and adapting them and reiterating this process based on the results of an experiment (Brunswicker et al. 2013). Moreover, the term 'piloting' is often used in a similar way to experimentation (Bocken et al. 2018). Yet, quite often business model experimentation is regarded as a smaller activity, as it can represent a small part of the business model (Schuit et al. 2017). Instead, the term 'pilot' could be used to refer to an entire business model trial with more complexity and using more resources than a smaller-scale experiment (Osterwalder et al. 2014; Bocken et al. 2018).

CBME is defined in the paper as 'an approach to explore the different possibilities that a business could create value from and understand what works in a real-life business context to significantly reduce the natural resource needs of business while creating positive value for customers, wider society and the environment in a fast, low resource way' (Bocken and Antikainen 2018: 4).

Need for CBMEs

Research suggests that we should abandon the classic stage-gate model in new product development (Cooper 2008; Tuulenmäki and Välikangas 2011) in favour of more iterative or effectual approaches to approach circular business model innovation (Weissbrod and Bocken 2017; Bocken et al. 2018). Because services (and similarly, business models) as opposed to products are intangible, often existing only in the moment of its delivery to a customer, it is difficult to isolate experimentation with services or business models within a traditional laboratory (Thomke 2003) or stage-gate process. Moreover, most innovative business model ideas are usually not ready to be fully implemented and need to be further developed by a series of rapid experimentations in which for example the value creation opportunities can be validated (Tuulenmäki and Välikangas 2011). Business model innovation covers all aspects of the firm and is a more holistic type of innovation than product innovation (Chesbrough 2010; Ries 2011). Hence, experimentation would need to take place within a real-life business context (Bocken et al. 2016).

Experimentation is regarded as mandatory for companies to keep up the pace in the ongoing changes in industries (Chesbrough 2010; McGrath 2010). Often, business model experimentations are referred to as an activity within limited time and other resources. Experimentations have been recognised as a key organisational capability to pursue radical innovation (Chesbrough 2010: Chang et al. 2012), and currently, the majority of the literature originates from start-ups (Ries 2011). However, experiments can be particularly useful for established businesses who require a sense of urgency in initiating experiments to remain competitive while tackling growing sustainability pressures (Amit and Zott 2001; Chesbrough 2010; Weissbrod and Bocken 2017 in Bocken et al. 2018).

The idea of using business model experimentations is to not only use one single experimentation, but also to design and run a series of experimentations (Fig. 19.1), which will pave the way towards a successful business model or product. After each experimentation, the results are to be rigorously analysed. Based on this analysis, a decision is made. There are typically three options: to run more experiments, to drop the

Fig. 19.1 Series of rapid experimentations

idea or radically change the idea or to scale the idea. If more experiments are needed, the learnings are utilised as a basis of the next round of experimentation. Therefore, a business model experimentation 'fails' only if there are no lessons learned. Thomke (2003) reiterates the need to make a clear distinction between 'failures' and 'mistakes'. By 'failure', he means a natural outcome of the experimentation process, which should be useful for learning. In contrast, the term 'mistake' refers to serious problems with the experimentation process, often caused by poor design (Thomke 2003).

Experimentations also answer to the challenges set by a high degree of customer and market uncertainty in the business model development process (Andries et al. 2013). These are apparent in circular business model innovation, as, for example, circular business models may involve entirely new markets and customer segments, and the uncertainty is high. To move towards circular business models, business experimentation will be an efficient tool to validate radically novel value creation opportunities (Weissbrod and Bocken 2017).

While sustainability issues are increasingly pressing, companies are taking the opportunity to test sustainable and circular value propositions to evaluate and test whether and how they can contribute to decreased negative environmental and societal impacts while increasing benefits delivered. Although there is a growing literature stream focusing on business model innovation and experimentation (e.g. Andries et al. 2013; Chesbrough 2010), there are only few publications on utilising circular business model experimentation in the business model innovation process (e.g. Weissbrod and Bocken 2017; Bocken et al. 2018, 2019).

Designing Circular Business Model Experimentations

Perspectives on Designing CBMEs

Currently, there is a very limited literature stream to guide companies in designing and implementing business model experimentations overall and only a few focusing on circular business models (Antikainen et al. 2017; Bocken and Antikainen 2018; Bocken et al. 2018). Thomke (2003) focuses on new product and process innovation and provides some guidelines and parameters for experimentations. Thomke (2003) similar to Ries (2011) and Blank (2013) underlines the importance of conducting experimentations and trying out a product/service on real customers, paying real money, in real economic transactions in order to gain reliability. Thomke (2003) highlights the importance of developing processes aiming for high reliability, as quickly and as cheaply as possible, that provide cumulative learning from a series of 'failures', before discovering a viable alternative business model. Similar to Thomke (2003), Tuulenmäki and Välikangas (2011) also state that 'execution innovation' (learning by doing) invites and builds upon many small failures that are treated as important learning points. Furthermore, The Lean Startup (Ries 2011) presents the same kinds of ideas, introducing the build-measure-learn feedback loop. The first step is in this approach is also to figure out the problem that needs to be solved and then to develop a minimum viable product (MVP) with which to begin the process of learning constituting multiple loops, as quickly as possible (Ries 2011). Ries' (2011) learning cycle is based on Blank's (2005) model of customer development, which is a four-step process and includes customer discovery, customer validation, customer creation and company building.

In order to design and run business model experimentations, it is important to understand the underlying processes and elements of the business model (Chesbrough 2010). One popular tool is the business model canvas by Osterwalder et al. (2010) that consists of nine business model building blocks. Based on the ideas presented in the business model canvas (Osterwalder et al. 2010), the Lean Startup methodology (Ries 2011) and customer development (Blank 2005, 2013), Osterwalder et al. (2014) present a practical guide, for startups as well as established organisations, on how to create the customer development cycle, and design and run rapid experiments. The experimentation process starts with extracting hypotheses, prioritising hypotheses, designing tests, prioritizing tests, running tests, capturing learnings and finally making progress (Osterwalder et al. 2014).

Osterwalder et al. (2014) offer a practically oriented method for designing and running experimentation and guiding businesses through the process, step-by-step. They also provide concrete tools for companies to facilitate process. Yet, their approach is focusing on the quantitative measurement of the experimentation. However, when innovating novel business models, it is often difficult or even irrational to set quantitative measurements. Instead, understanding the qualitative aspects may offer more fruitful data.

Process-Oriented Approach to Circular Business Model Experimentation

The existing literature on circular business model experimentations suggests using a process-oriented model approach (Antikainen et al. 2017; Bocken and Antikainen 2018; Bocken et al. 2018). The process can be divided into five broad phases (Fig. 19.2). The arrows in the figure suggest that this process is iterative and often moves backwards and forwards between different steps. The pace of each of the phases can be fast. However, sometimes phases might take longer (in particular, practical planning and implementation), because of business timings and decision-making or even a lack of resources (time, money, people), despite the low-resource nature of experiments (Weissbrod and Bocken 2017). After Step 5 (data analysis), one might move back up to ideating or any of the other steps, such as immediate planning of new

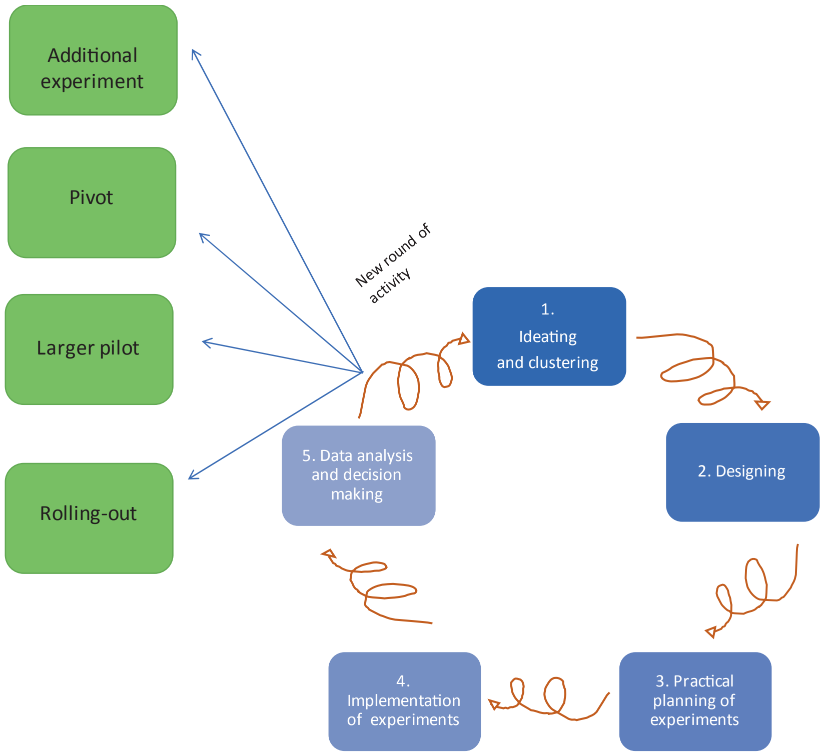

Fig. 19.2 Business model experimentation process model (*Source* Developed from Bocken et al. [2018], Osterwalder et al. [2014], Schuit et al. [2017] and Antikainen et al. [2017])

experiments based on the outcomes. Another solution is to move to a larger-scale pilot if successful (Osterwalder et al. 2014). Quite often when starting to test a novel idea, a series of experiments (see Fig. 22.2) are needed before moving to other steps.

Step 1. Ideating and Clustering the Business Models

Before moving towards the business model experimentation, there should be a clear idea of novel business model to be tested. The purpose of the ideation phase is to rapidly generate as many viable business model ideas as possible, with a positive environmental impact (e.g. reduced clothing waste to landfill) and business potential (Bocken et al. 2018). Several tools exist to facilitate the business model innovation. For example, the value mapping tool can help to explore the value creation opportunities for stakeholder sustainable business models (Bocken et al. 2013). Furthermore, circular business model innovation tool based on the business canvas (Osterwalder et al. 2010) can help companies to innovate new business models as well as evaluate the circularity, sustainability and reflect the idea with the ongoing trends (Antikainen and Valkokari 2016).

Step 2. Design

The second step is the design of a business model experiment. Designing the experimentation is extremely important in order to provide valid and reliable results for the selected hypotheses. The hypotheses are chosen based on its importance for the success of the new business model. Thus, the question to consider is ‘What is the most important thing to make this model successful?’ There can be many answers, which makes it important to prioritise hypotheses. One business model experimentation can focus on validating only one or several hypotheses but it is often recommended to focus on a major hypothesis (Ries 2011). Validating several hypotheses highlights the importance of the experimentation design phase even more. A working business model ‘pilot’, which can be seen a next step from business model experimentation, often has several hypotheses to test.

As a tool to facilitate the design of the research, Rapid Experimentation Cards (REC) (Antikainen et al. 2017; Fig. 19.3) were developed on the basis of Test Cards (Osterwalder et al. 2014). The main difference between Osterwalder's et al. (2014) Test Cards is that REC leverages the measurement to also include qualitative aspects. The qualitative approach enables to increase understanding of the novel ideas that are difficult or even impossible yet to be quantified. Each hypothesis requires its own card.

Step 3. Practical Planning of Experiments

The third step consists of the practical planning of the rapid business model experimentation, which often requires quite intensive work. The planning includes both practical part planning and planning of the research part. In order to run experimentations in practice, there is often a need to find new partners to secure funding and necessary

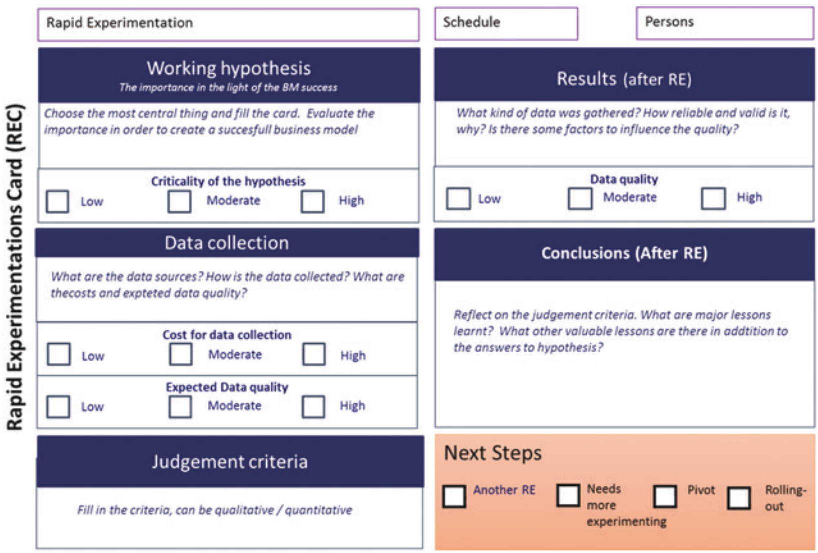

Fig. 19.3 Rapid Experimentation Card (*Source* Antikainen et al. [2017])

resources, thus, this step might need a considerable amount of negotiations, contracts and communication planning. Communication is an essential part of the planning, while often there can be major benefits gained through the publicity of the business experimentation (Antikainen et al. 2017). In addition to image benefits, publicity can help to find potential users or customers for the rapid experimentation. When considering business model experimentations also organisational capabilities have to be taken into account (Weissbrod and Bocken 2017) and the plan for the needed additional resources needs to be made on that basis. The planning of research includes the planning and scheduling of the data collection and analysis as well as the identification of the resources. It should be noted that when planning is done without partners, this process may be more efficient. However, in the CE experimentation, partners are likely to be quite important (e.g. service providers, recyclers and distribution companies) (Kraaijenhagen et al. 2016). Moreover, individual experiments initiated by a focal company may later be followed by collaborative ones.

Step 4. Implementation of the Business Model Experimentation

The fourth step is the implementation of the rapid experimentation. This step includes also the data collection, which should be done in a deliberate way. Often an experiment focuses on testing one hypothesis at a time, such as customer traction (Ries 2011). Obviously, other learning will be collected, but the main hypotheses (e.g. service X will attract Y customers) need to be tested. This is the step that might require most resources and might result in surprises and challenges requiring agile modifications of the plan and implementation of the practicalities and research. Therefore, the process of experimentation has to be seen as rather iterative rather than a structured stepwise process. Identifying core stakeholders for the rapid business model experimentation and active multi-channel communication for this group plays an important role in this phase. For example, a significant investment for marketing and communication for the potential customers might be needed in order to gain the minimum amount of the needed users for the experimentation.

Step 5. Data Analysis and Decision-Making (After Which Step 1 May Be Repeated)

After the implementation phase, the next important step is data analysis, where the collected data, usually from multiple sources, is analysed and evaluated (Ries 2011). At this stage, REC (Antikainen et al. 2017), which are aimed for companies to help planning and conducting experimentations, can be used as to analyse the data and reflect the gained results with the actual plan. Most important, in this phase is to find answers to the hypothesis. There also might be other data sources than in the planning phase was suggested. In this phase, it is important to keep in mind that the experimentation only fails in case the data collection and the analysis fails. Therefore, all learnings are important and all the data should be used as a base for decision-making for the next steps. In addition to answering the hypothesis, analysis can be leveraged to give other suggestions and answer other research questions.

Finally, the conclusions are drawn and planning of the next steps planned for the next business model experimentations. Building on the REC (Antikainen et al. 2017) one of the following options may be selected (see Fig. 19.2): (1) needs more experimentation, (2) needs a larger pilot, (3) ready to be scaled, and (4) needs major changes (i.e. a pivot). This decision is influenced by the (a) qualification/discarding the hypothesis, (b) learnings from the earlier rapid experimentations, and (c) criticality of the currently tested hypothesis. Depending on the result, a rapid experimentation can produce ideas what are next steps to be tested.

Next, we present our case study on Liiteri. We illustrate the different phases identified from the process and analyse the experimentation process by highlighting identified challenges and gained benefits in different phases.

Case Liiteri—Renting Tools and Cleaning Equipment

Description of the Case

Currently, many consumers own tools that are not used regularly. The whole usage-time for a tool during its life cycle can even be under 10 minutes. These tools need storage space and require maintenance. Therefore, a more efficient and also environmentally friendly solution would be to rent a tool when needed. These kinds of rental services have been popular in B2B markets and new B2C services have been launched lately. Yet, there is still a need for novel services that are easy and attractive for consumers.

A start-up company, called CoReorient (www.coreorient.com) was interested in developing a novel tool and cleaning equipment rental service for consumers, which can also be developed into a larger service platform (Antikainen et al. 2017). Yet, before launching a novel service, the business model needed to be piloted in order to understand how to offer superior value for consumers instead of existing models (owning) and also to make a sustainable business model. Therefore, Liiteri.net was established by the Finnish startup CoReorient (www.coreorient.com) and implemented with the collaboration of the Finnish hardware store KRauta and an AARRE research project (http://www.vtt.fi/sites/AARRE). Liiteri (www.liiteri.net, www.townhall24.fi) was designed and implemented during September–December 2016.

The Liiteri platform comprised of three different service platforms, i.e. an outsourced online platform, a 24/7 self-service pickup point with access control and a PiggyBaggy home delivery service. The data included the design and set-up phases, running phase as well as a crowdfunding experiment at the end. During the piloting, 100 users registered for the Liiteri service, and during the pilot, 44 rental transactions took place.

Experimentation Process

Liiteri Step 1. Ideating the Pilot

In order to offer tools as flexible as possible, the idea was that customers are able to pick up the tools at a 24/7 Liiteri self-service point (intelligent container), which was initially planned to be located at the new metro station in Espoo. Yet, the plan changed because of the substantial delay of the completion of the metro. Therefore, the Liiteri was placed at Teurastamo, Helsinki, which is accessible by public transport but not attracting as many passers-by than the metro station.

In addition to visiting Liiteri, consumers were also able to order home delivery with the crowdsourced PiggyBaggy (www.piggybaggy.com) service. The Liiteri pilot also offered other services, such as a virtual shoe repair service and bike repair service. As such, Liiteri included many elements of a business model offering a whole service for consumers. Therefore, Liiteri can be regarded as a larger-scale pilot, running several business model experimentations simultaneously. Challenges identified in this phase were related to the ability to build a flexible plan that enables justifications if rapid changes are needed.

Liiteri Step 2. Design

After the first ideation and idea-clustering phase, in the second step, the entrepreneur and researchers started to design the pilot. In this process, REC were utilised (Fig. 19.3) to facilitate the process, and during the process, the cards were also iteratively developed (Antikainen et al. 2017). The aim was to test the chosen hypotheses with the real mainstream customers. With the Liiteri pilot, the entrepreneur in collaboration with the research organisation aimed to test several hypotheses. The first and the most critical hypothesis was formulated as 'We believe that renting tools is an attractive service for consumers, compared to buying'. Therefore, the first hypothesis was set to test the value creation to consumers: 'We believe that the service model creates value, in multiple ways, for consumers (benefits greater than sacrifices)'. The entrepreneur also believed that *accessibility* (24/7) and *convenience* (e.g. home delivery) could be relevant differentiators from incumbent services, and thus, the second hypothesis was set: ‘We believe that Liiteri is easier to use (accessibility/convenience) for consumers than buying or using existing services’. The last three hypotheses were related to the value creation for the whole network, environmental impact and competitive pricing.

The design stage might be time-consuming and require a substantial amount of collaboration with stakeholders to be able to choose the most critical hypothesis/hypotheses as well as to choose measurements for validating.

Liiteri Step 3. Practical Planning of Experiments

Close collaboration with all the partners of the business model experimentation is an important part of this step. The communication and collaboration with the large group of partners needed lot of time and effort. However, this challenge was tackled by having experienced and active communication personnel in the start-up company. Since Liiteri was conducted in close collaboration with a research project, in the planning phase the roles and responsibilities between the entrepreneur and the research organisations were defined. The former was responsible for arranging and running the pilot, itself, as well as for collecting the quantitative data (number of users etc.) during the pilot, along with customer feedback, for further analysis. The researchers were responsible for planning the research in collaboration with the entrepreneur, collecting data in the form of consumer and user questionnaires and interviews and analysing the jointly acquired data, after the pilot. The roles and responsibilities need to be clear to avoid misunderstandings and to facilitate efficient process in next steps.

Liiteri Step 4. Implementation of Business Model Experimentation

At the beginning of the implementation phase, one of the most challenging tasks was to reach the objective of building a minimum viable pilot set-up capable of producing reliable results with the resources allocated. The usability of the service was not as good as planned, which caused errors and feedback from the users. Presumably, the active use of social media and media visibility were important factors contributing to the success of the pilot in attracting a critical amount of users. Based on the data, the usage rate of the additional services remained low, yet because of the lack of data, conclusions cannot be drawn.

During the pilot, there were significant bottlenecks related to the most popular tools, such as a steam washer. This led to the situation that the waiting time for these most popular tools grew too long and the users lost their interest in the service.

Liiteri Step 5. Data Analysis and Decision-Making (After Which Step 1 May Be Repeated)

In the data analysis phase, all the data from multiple sources were collected and analysed by using the REC cards. Due to our five hypotheses, we got five REC cards filled. The results of the most critical hypothesis are presented in Fig. 19.4.

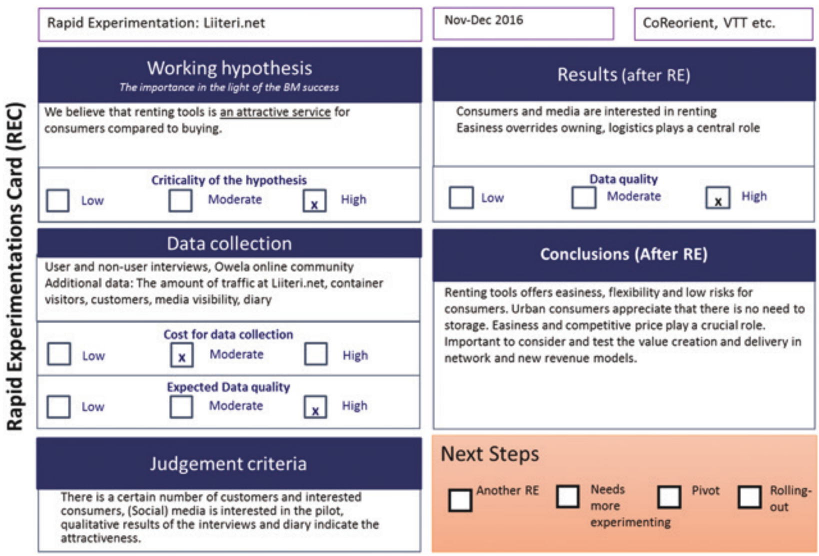

Fig. 19.4 Liiteri rapid mode experimentation card (Antikainen et al. 2017)

As a result, the Liiteri pilot confirmed that renting tools was found to be an interesting service for urban consumers. Convenience and competitive price plays a crucial role. Furthermore, in order to be attractive, the logistics related to the usage of the service need to be smooth and easy. This can either be solved with innovative home delivery solutions or central locations of the container. This is also required to make the service environmentally sustainable. For stakeholders, the model requires mind-set change and innovative thinking how value is delivered as well as finding novel sources of value (e.g. by offering maintenance services or more holistic customer solutions). The conclusions drawn suggested that another pilot in different location would be needed to bring more understanding on the value proposition and pricing of the model.

Discussion and Conclusions

Experimentation with new circular business models is necessary to start the transition to a CE. This chapter has presented a process-oriented view on experimentation illustrating the confronted challenges in different steps based on the empirical data from our case study Liiteri.

Only a few tools and approaches to date focus on experimentation with some exceptions (Antikainen et al. 2017; Bocken et al. 2018). This work presents a potential approach to circular business model experimentation. However, it should be noted that in dynamic and turbulent business environments, and with pressing sustainability challenges, a process as structured as the product-innovation stage-gate process (Cooper 2008) is not appropriate anymore (Tuulenmäki and Välikangas 2011). Figure 19.2 thus presents a seemingly stepwise process but the iterative nature of this process (as opposed to stage gates in product-innovation processes) is emphasised. Nevertheless, a rigorous approach to experimenting is required, similar to experimenting in other contexts, where specific set-ups, hypotheses, measures, and learning are applicable. As also recommended by the Lean Start-up approach (Ries 2011), experiments should be focused and have specific hypotheses and measures. Also, experiments need to be followed up with specific actions (e.g. pivot, more experiments, pilot, scale up).

In designing and implementing circular business model experimentations, there are many challenges to be tackled. In our case study, we highlighted the challenges related to feasibility of the needed technology, surprising environmental challenges and challenges related to the scalability. Also, the collaboration between company and other stakeholders as well as communication and visibility are relevant challenges that we identified. Furthermore, during the implementation phase, the organisers might face surprises that need immediate reactions and change of original plans. Our process-oriented approach can be used as a practically oriented planning guide for companies and other organisations when applying sustainable business model experimentations. Furthermore, it might help organisations to focus on the most relevant issues that are also most prone for challenges during the process.

Future research in this area is certainly needed to explore and share understanding about what the major challenges are related to design, implementation and evaluation of the business model experiments. Large businesses aiming to transform their business model into a circular model need guidance to face the challenges in starting to utilise business model experimentations. Furthermore, both businesses and research organisations need more guidance and tools for business model experimentation processes and integration of the process as a part of the business model innovation process. Moreover, the wider context in which experimentation takes place (e.g. infrastructure, linkages to existing business models) need to be more clearly understood (Boons and Bocken 2017) and impacts of new business models need to be measured and acted upon to develop more sustainable business models (Manninen et al. 2018).

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References

Amit, Raphael, and Christoph Zott. 2001. "Value creation in e-business." *Strategic Management Journal* 22: 493–520. http://doi.wiley.com/10.1002/smj.187.

Andries, Petra, Koenraad Debackere, and Bart van Looy. 2013. "Simultaneous experimentation as a learning strategy: Business model development under uncertainty." *Strategic Entrepreneurship Journal* 7 (4): 288–310. Wiley-Blackwell. https://doi.org/10.1002/sej.1170.

Antikainen, Maria, and Katri Valkokari. 2016. "A framework for sustainable circular business model innovation." *Technology Innovation Management Review* 6 (7). http://timreview.ca/article/1000.

Antikainen, Maria, Anna Aminoff, Harri Paloheimo, and Outi Kettunen. 2017. "Designing circular business model experimentation—Case study." In *The Proceedings of the 2017 ISPIM Forum*, 19–22, Toronto, Canada.

Blank, S. 2005. *The four steps to the epiphany: Successful strategies for products that win*, 5th ed., 1st ed. San Francisco, U.S.: K&S Rach Publishing.

Blank, S. 2013. *The four steps to the epiphany: Successful strategies for products that win*. BookBaby.

Bocken, N., F. Boons, and B. Baldassarre. 2019. "Sustainable business model experimentation by understanding ecologies of business models." *Journal of Cleaner Production* 208: 1498–512.

Bocken, N., Samuel Short, Padmakshi Rana, and Steve Evans. 2013. "A value mapping tool for sustainable business modelling." *Corporate Governance (Bingley)*. https://doi.org/10.1108/CG-06-2013-0078.

Bocken, Nancy M. P., and Maria Antikainen. 2018. "Circular business model experimentation: Concept and approaches." In *KES SDM 2018*, June 24–26, Melbourne.

Bocken, Nancy M. P., Ilka Weissbrod, and Mike Tennant. 2016. "Business model experimentation for sustainability." 297–306. Cham: Springer. https://doi.org/10.1007/978-3-319-32098-4_26.

Bocken, N. M. P., C. S. C. Schuit, and C. Kraaijenhagen. 2018. "Experimenting with a circular business model: Lessons from eight cases." *Environmental Innovation and Societal Transitions*.

Bocken, Nancy M. P., Karen Miller, Ilka Weissbrod, Maria Holgado, and Steve Evans. 2017. "Business model experimentation for circularity: Driving sustainability in a large international clothing retailer." *Economics and Policy of Energy and the Environment* 2017 (1): 85–122. https://doi.org/10.3280/EFE2017-001006.

Boons, Frank, and Nancy Bocken. 2017. "Business models and the sharing economy: An ecosystem perspective." In *Product Lifetimes and the Environment (PLATE)*, November 8–10.
Boons, Frank, Carlos Montalvo, Jaco Quist, and Marcus Wagner. 2013. "Sustainable innovation, business models and economic performance: An overview." *Journal of Cleaner Production*. https://doi.org/10.1016/j.jclepro.2012.08.013.
Brunswicker, Sabine, Cara Wrigley, and Sam Bucolo. 2013. "Business model experimentation: What is the role of design-led prototyping in developing novel business models?" 139–51. Cham: Springer. https://doi.org/10.1007/978-3-319-00179-1_13.
Chang, Y. C., H. T. Chang, H. R. Chi, M. H. Chen, and L. L. Deng. 2012. "How do established firms improve radical innovation performance? The organizational capabilities view." *Technovation* 32 (7–8): 441–51.
Chesbrough, Henry. 2010. "Business model innovation: Opportunities and barriers." *Long Range Planning* 43 (2–3): 354–63. Pergamon. https://doi.org/10.1016/J.LRP.2009.07.010.
Cooper, Robert G. 2008. "Perspective: The Stage-Gate® idea-to-launch process—Update, what's new, and NexGen Systems." *Journal of Product Innovation Management* 25 (3): 213–32. Wiley/Blackwell (10.1111). https://doi.org/10.1111/j.1540-5885.2008.00296.x.
De Vaus, David A. 2001. *Research design in social research*. London: Sage.
Ellen MacArthur Foundation. 2013. *Towards the circular economy Vol. 1: An economic and business rationale for an accelerated transition*.
Geissdoerfer, M., P. Savaget, N. M. Bocken, and E. J. Hultink. 2017. "The circular economy—A new sustainability paradigm?" *Journal of Cleaner Production* 143: 757–68.
Hoogma, Remco, Rene Kemp, Johan Schot, and Bernhard Truffer. 2005. *Experimenting for sustainable transport*. Routledge. https://doi.org/10.4324/9780203994061.
Kraaijenhagen, Christiaan, Cécile van Oppen, and Nancy Bocken. 2016. *Circular business: Collaborate and circulate*. Amersfoort: Circular Collaboration.
Manninen, Kaisa, Sirkka Koskela, Riina Antikainen, Nancy Bocken, Helena Dahlbo, and Anna Aminoff. 2018. "Do circular economy business models capture intended environmental value propositions?" *Journal of Cleaner Production* 171 (January): 413–22. https://doi.org/10.1016/J.JCLEPRO.2017.10.003.

Markard, Jochen, Rob Raven, and Bernhard Truffer. 2012. “Sustainability transitions: An emerging field of research and its prospects.” *Research Policy* 41 (6): 955–67. https://doi.org/10.1016/j.respol.2012.02.013.

McGrath, Rita Gunther. 2010. “Business models: A discovery driven approach.” *Long Range Planning* 43 (2–3): 247–61. https://doi.org/10.1016/J.LRP.2009.07.005.

Osterwalder, Alexander, Yves Pigneur, and Alan Smith. 2010. *Business model generation*. Hoboken, NJ: Wiley. https://doi.org/10.1523/JNEUROSCI.0307-10.2010.

Osterwalder, Alexander, Yves Pigneur, Greg Bernarda, and Alan Smith. 2014. *Value proposition design: How to create products and services customers want*. Wiley.

Ries, Eric. 2011. *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. New York: Crown Books.

Schuit, C. S. C., B. Baldassarre, and N. Bocken. 2017. “Sustainable business model experimentation practices: Evidence from three startups.” *Product Lifetimes and the Environment 2017—Conference Proceedings* 2013: 370–76. https://doi.org/10.3233/978-1-61499-820-4-370.

Seiffert, Mari Elizabete B., and Carlos Loch. 2005. “Systemic thinking in environmental management: Support for sustainable development.” *Journal of Cleaner Production* 13 (12): 1197–202. https://doi.org/10.1016/J.JCLEPRO.2004.07.004.

Thomke, S. H. 2003. *Experimentation matters: Unlocking the potential of new technologies for innovation*. Harvard Business Press.

Tuulenmäki, Anssi, and Liisa Välikangas. 2011. “The art of rapid, hands-on execution innovation.” *Strategy & Leadership* 39 (2): 28–35. https://doi.org/10.1108/10878571111114446.

Weissbrod, Ilka, and Nancy M. P. Bocken. 2017. “Developing sustainable business experimentation capability—A case study.” *Journal of Cleaner Production* 142 (Part 4): 2663–76. https://doi.org/10.1016/J.JCLEPRO.2016.11.009.

Wells, P. E. 2013. *Business models for sustainability*. Cheltenham, Gloucestershire, UK: Edward Elgar Publishing. ProQuest ebrary, Web. 7 December 2016.

WWF. 2016. *Living planet report summary.* Accessed December 16, 2017. Available at: http://awsassets.panda.org/downloads/lpr_living_planet_report_2016_summary.pdf.

20

Game-Based Approaches to Sustainable Innovation

Katherine Whalen and Gerben Kijne

Introduction

Due to their risk-free environment, game-based approaches have been adopted by companies and institutions as vessels for training and development and applied to situations that include military training and water management planning (Michael and Chen 2006). This trend has not escaped the field of sustainability. Within classrooms, academics have adopted game-based approaches to increase students' knowledge of critical raw materials

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(Fernández Sánchez 2018), system dynamics (Fishbanks 2018), and sustainable development (Dahlin 2018). Within industry, large companies such as Airbus have incorporated games on eco-efficiency into their training programmes (Despeisse and Lunt 2017), and consultants have developed social simulations based on the UN Sustainable Development Goals to assist companies in spurring organizational innovation (Solutions 2018).

This chapter addresses how two game-based approaches—serious games and gamification—have been applied to sustainable innovation. After making a distinction between these two different approaches, we investigate serious games as support tools for sustainable innovation before reflecting on how gamification can be used to encourage environmentally friendly behaviour. The chapter finishes by reflecting on the benefits and limitations of both approaches.

Background on Game-Based Approaches

We begin with a brief overview of game-based approaches and the differences between serious games and gamification. *Serious games* differ from traditional games in that they are not only played for amusement (Abt 1987). As stand-alone activities designed to educate and inform, serious games may take either digital or physical forms and have been used in both educational and industrial settings. In the context of sustainable innovation, we will discuss serious games used for sustainable business model innovation. A number of these serious games have been adopted by organizations looking to integrate sustainability in their operations and support the 'fuzzy front end' of sustainable product and business model innovation.

Gamification, on the other hand, is used to change or influence behaviour by applying game elements to non-game contexts (Kasurinen and Knutas 2018). In contrast to serious games which are stand-alone

Table 20.1 Game elements summarized by the authors based on Fullerton and Swain (2008)

Game element	Description
Objective	Specific goal(s) for the players to achieve
Gameplay	Describes how the game is played and what occurs in the game
Players	Who and how many are playing
Rules	Define the procedure and player behaviour
Challenge	Level of difficulty. Should be set to ensure players are continually engaged
Player interaction	Describes how the players interact. Competition and/or cooperation can motivate players
Chance/Control	Dictates the players' level of control. Control over the outcome of the game can motivate players
Resources	Game objects that enable players to reach the objective
Feedback mechanisms	Enable tracking of the process and progress

activities, gamification focuses on influencing people as they go about their everyday life, often by utilizing persuasion and persuasive design (Froehlich 2015). Players are rewarded for their accomplishments through social recognition, points, or even monetary value. Within the context of sustainable innovation, gamification can help support the transformation to sustainability by encouraging and rewarding real-life sustainable actions and behaviour.

Game elements are used in both serious games and gamification to influence gameplay and player motivation. Table 20.1 draws on the work of game designers Fullerton and Swain (2008) and presents some common game elements. Throughout the chapter, we will utilize this terminology in our description of games. Specific cases of game-based approaches selected from practice are also used to provide concrete examples. Table 20.2 introduces and provides a brief overview of these cases.

Table 20.2 Overview of case examples discussed in the chapter

Serious games for sustainable business model innovation	Purpose	Objective	Gameplay	Assessment
E-Mobility Business Model Gaming (Laurischkat and Viertelhausen 2017)	Assist in the development of innovative business models for e-mobility solutions	Develop an e-mobility business model	A moderator guides teams through four phases. Players take on the role of stakeholders in electric mobility. A physical game is used with cards where players build their business model and collect victory points. New scenarios are then introduced and players must innovate and simulate their business model outcomes	In the final phase, players assess their business model and its long-term competitiveness using the presented business model scenarios
Play it Forward (DeWulf 2010)	Assist the implementation of sustainability, particularly in the early product innovation process	Compete against another team to achieve the most sustainable business model	Physical game where two teams work through the various elements of the Business Model Canvas—one from a technology-driven perspective, the other from a market-driven perspective; teams are also confronted with STEEP innovation cards and must consider the robustness of their business model in addressing these issues	Business models are assessed by a scorecard of 'People, Planet, Profit' that is marked by an objective third party

(continued)

Table 20.2 (continued)

Serious games for sustainable business model innovation	Purpose	Objective	Gameplay	Assessment
Risk & Race (Whalen 2017)	Assist circular business model innovation & model financial aspects	Compete against other players to achieve business continuity and the most sustainable business model	Physical board game where players are manufacturing companies who must acquire resources, produce products, and manage elements of their business model. The game is played in rounds; conditions (reflecting PESTEL forces) change each round	Players assess their business model at the end of five rounds based on the number of remaining resources, finances, investment decisions, and emissions

Gamification for sustainable transformation	Purpose	Objective	Description of play	Assessment
Age of Energy (Energy 2016)	Encourage 16–25 year olds to begin performing energy saving actions with the final goal of changing behaviour	Complete in-game objectives and compete with friends	A mobile game focused on village building and conquering in which real-world energy saving actions give players in-game benefits	Players receive feedback on their energy saving accomplishments (after about three weeks of play)

(continued)

Table 20.2 (continued)

Gamification for sustainable transformation	Purpose	Objective	Description of play	Assessment
Recyclebank (Recyclebank 2017)	Encourage general public to adopt sustainable behaviour including recycling and waste reduction	Earn points and redeem them for rewards	Players earn points for performing green actions such as recycling; points can also be earned through online quizzes that aim to increase player's sustainability-related knowledge	Points awarded from online platform and in real life
TwoGo (TwoGo 2017)	Motivate SAP employees to carpool	Earn points and receive rewards such as priority parking	Digital app where players earn points by performing ride sharing-related activities in real life	Tallying points

Serious Games for Sustainable Innovation Processes

Given the differences between serious games and gamification, we now separately reflect on how these two game-based approaches can be used to aid sustainable business transformations. This section focuses on how serious games can be used to assist sustainable innovation as undertaking such processes inevitably means a change in business thinking and operations. In comparison with traditional innovation, sustainable innovation includes the involvement of a wider range of stakeholders such as the consideration of societal and environmental values, which are generally considered to be secondary to economic value for most firms (Freeman and Gilbert 1992; Stubbs and Cocklin 2008). As such, individual actors cannot act according to their own interests; instead, it is necessary to take a systemic perspective.

Finding ways to embed this in innovation processes can be a challenge. The wickedness of sustainability means it addresses many interconnected issues, and there are no clear answers. Yet, while there is no consensus on how firms should approach embedding sustainability (Bocken et al. 2014), numerous authors view the business model as a means to approaching (sustainable) innovation (Bocken et al. 2013; Boons and Lüdeke-Freund 2013; Johnson and Suskewicz 2009; Schaltegger et al. 2016). Simply put, 'a business model describes the rationale of how an organization creates, delivers, and captures value' (Osterwalder and Pigneur 2010). Although business models centre on a focal firm, their boundaries are not limited to those of the firm as they can be used to describe the value creation logic for different stakeholders (Zott and Amit 2010).

Various tools have been developed to assist sustainable business model innovation. This includes the value mapping tool of Bocken et al. (2013), the Sustainability Balanced Scorecard of Hansen and Schaltegger (2016), and numerous serious games. As shown in Table 20.2, we have selected three recent cases used in industry for further reflection. While these serious games may differ in objective and gameplay, a number of commonalities are visible.

First, all such games are guided by a set of principles (i.e. rules) (Wang et al. 2009), and as illustrated by the examples noted in this chapter, these principles often draw on theoretical innovation process models such the Business Model Canvas (Osterwalder and Pigneur 2010). For example, Play it Forward uses a Business Model Canvas adjusted for sustainable business models as its main game board (DeWulf 2010). Business model components (Osterwalder et al. 2005) feature in the gameplay of E-Mobility Business Model Gaming, as players must analyse customer segments and re-design their value proposition, customer interaction, and profit model (Laurischkat and Viertelhausen 2017). Risk and Race also draws on the Business Model Canvas and contains business model elements such as two different types of sales channels (Whalen 2017). With this approach, players can adapt or change various aspects of these components in order to alter their business model.

Second, in all serious games, players are guided with an objective. Like innovation processes themselves, there is no predetermined outcome. However, players must have a tangible way to measure the outcome. In the example cases, as illustrated in Table 20.2, this includes counting fictitious points (such as victory points that are awarded to players for doing certain actions) or simply scoring the business model's sustainability from numerous criteria.

Finally, the complexity of real organizations' business environments (such as return on investment uncertainty as mentioned in Linder and Williander [2015]) is often reflected in sustainable innovation serious games. The element of chance may be used to change gameplay and encourage players to consider and experiment with how to respond to shifts in their internal, operational, or external business environment. This could mean players having to decide whether to be reactive or proactive in addressing changes to eco-design legislation or resource availability.

Gamification for Sustainable Transformation

We now introduce gamification as a second game-based approach to sustainable innovation. Unlike serious games where an entirely new game world with its own rules and procedures is created, gamification does not entirely separate the real world from the game world. Instead, game elements, such as those described in Table 20.1, are applied within the real-world context. For sustainability, this means encouraging more sustainable actions and influencing behaviour through game-based approaches (Froehlich 2015). Here, gamification involves applying game elements to non-game contexts, such as receiving a reward when a specific sustainable action is performed (i.e. shutting off lights).

In contrast to our previous reflection on serious games, we do not limit our discussion on gamification to a firm-based perspective. In fact, gamification has been widely used to assist the general public in transitioning to a more sustainable society (Baylis et al. 2014). For example, while a significant portion of the world's population is aware of climate change (Lee et al. 2015), these issues can be overwhelming: What can you do as one person—and where do you even start? Here, gamification may be a way to make it easier for consumers to make sustainable choices. As an action-oriented approach, gamification can help impart change by breaking down the issues into manageable, trackable actions. Although these actions alone may seem inconsequential, overtime they compound and add up.

Examples of gamification for sustainable innovation have targeted changing consumer behaviour in the home. From those listed in Table 20.2, this includes a game in development called Age of Energy, which encourages players to use less energy and Recyclebank, which motivates users to recycle more through a points and rewards scheme. However, sustainable gamification is not only aimed at individuals. Companies such as SAP's TwoGo may use gamification internally to influence sustainable actions by employees or measure employee performance. As a bonus, this information can be documented and included in sustainability reports.

Challenges and Benefits of Using Game-Based Approaches for Sustainable Innovation

Having presented the two game-based approaches, this discussion section centres on possible challenges and benefits of applying games to sustainable innovation. We first reflect on the challenges of assessing game-based approaches, as identifying the actual outcomes of such games is crucial to ensure these interventions are useful for the transformation to a more sustainable society. We then introduce benefits of game-based approaches in relation to sustainable innovation.

Various approaches to assessing gaming outcomes have been proposed (Watt 2009). These include embedding assessment methods into gameplay or conducting an external evaluation after play has finished, such as through a survey (Caballero-Hernández et al. 2017). In our experience, however, assessing the actual impact of games is a challenge. Games created by industry may not be held to rigorous, independent assessment, and even those developed in academic settings may not be scientifically evaluated. For example, after reviewing research on twenty-five different environmental management serious games, Madani et al. (2017) criticized the studies for their general lack of methodological approaches and quantitative assessment methods. Still, in comparison with serious games, gamification interventions may be easier to measure and quantify as they directly alter players' actions outside the game world (Visch et al. 2013).

The games previously presented in Table 20.2 exemplify some of the challenges that game designers and researchers face when attempting to quantify the outcomes of game-based approaches. Three of the given examples (Age of Energy, E-Mobility Business Model Gaming, and Risk and Race) are still in the pilot phase and currently collecting feedback from usability tests. The remaining three (Play it Forward, Recyclebank, and TwoGo) are in use by industry, but access to information about them is limited. Thus, to further our reflection on challenges and benefits, we expand our discussion to include additional games where outcomes have been quantified and reported.

Here, a variety of studies suggest implementing game-based approaches can reduce environmental impact. Use of Opower's energy consumption reports—where users receive an efficiency rating and are able to compare their electricity consumption to that of their neighbours—averaged a 2% reduction of energy consumption (Allcott 2011; Ayres et al. 2009). More economical driving behaviour was also reported by some drivers when game elements such as instantaneous feedback were applied to car dashboards to monitor and encourage eco-driving (Stillwater and Kurani 2011). We refer readers to Owen

(2017) and Froehlich (2015) for even more case examples of specific and quantifiable gaming outcomes related to energy, cost, and waste reduction.

However, the positive impacts achieved from using games may not be long term. Competition-based challenges—such as where a reward is given to the participants who recycle the most during a set amount of time—have shown to have only a temporary effect (Witmer and Geller 1976; Schnelle et al. 1980). Engagement may also be short-lived. For example, Trash Tycoon, a game about upcycling with almost 20,000 likes on social media platform Facebook shut down after nine months as developers '(felt) the game (had) run its course' (Tycoon 2012; Fox 2011). This is not unique to the field of sustainability—within the first three months after launching, the viral mobile game Pokemon Go saw an 80% decrease in the number of daily US-based players (Siegal 2017).

Other critiques of game-based approaches target the required preparation and facilitation necessary in their development and implementation. First, before game-based approaches can be used, they must be developed and tested. This is time-consuming and costly, especially if a digital game is being produced. One current trend in game-based approaches—game platforms that allow users to create their own game—could address this by enabling easier game creation. Such approaches are being supported by industry and government initiatives such as the project 'Digital Improvement by Game In Teaching' funded by Erasmus + 2017 (an EU programme for education, training, youth, and sport). However, even if a game is developed, a potential user may decide to not use a game because of time limitations. (To give an impression, the games discussed throughout this chapter range in playing time from fifteen minutes to eight hours). Finally, while gamification approaches do not usually require additional facilitation, serious games are not recommended as stand-alone objects and an experienced facilitator or educator is usually encouraged to successfully place a game within a broader context (Sitzmann 2011; Whalen et al. 2018). This not only takes additional time but demands additional expertise and preparation.

Nevertheless, we find game-based approaches compliment and bring a fresh, new perspective to sustainable innovation, especially where previous approaches have been criticized for being vague and theoretical (Laurischkat and Viertelhausen 2017). The ability of games to illustrate complexity in an approachable and understanding way enables them to depict the wicked problems of sustainable development. The interaction and engagement levels achievable through games (Connolly et al. 2007), as well as their assistance with critical thinking (Ke 2009), are also attractive to those wanting to engage others in sustainable development issues. For example, applications of games within the classroom have found participants to become emotionally invested in the topic of sustainability ethics (Sadowski et al. 2013).

Furthermore, customization has been shown to increase motivation (Cordova and Lepper 1996), and the adaptability of games, such as by allowing the user to choose challenges or personalize elements, can increase engagement (Turkay and Adinolf 2010, 2015). While this is perhaps easier in digital games, this can also be done in non-digital games. For example, serious games may have 'expansion' packs that increase the challenge level in order to maintain user motivation.

Finally, other characteristics of game-based approaches such as time compression (Michael and Chen 2006) are well suited to sustainable innovation. By simulating possible outcomes and allowing players to experience the consequences of certain actions, otherwise unperceivable long-term effects may become tangible. This is especially relevant to sustainability where the long-term return on investment is often not relatable (Whalen 2017). These elements of realism not only enable players to observe potential outcomes, but also learn from them. As active reflection is a critical part of the learning process (Kolb and Kolb 2005), the feedback embedded in game-based approaches provides players with the opportunity to reflect on their actions and choices (Garris et al. 2002).

Conclusion

This chapter has outlined the potential of using game-based approaches for sustainable innovation by addressing serious games and gamification. Our investigation of serious games for sustainable innovation has shown that this approach is used to provide structure to open-ended innovation processes. This is ideal due to the inherent nature of sustainability, where challenges are complex and open-ended and a wide range of stakeholders must be considered. On the other hand, gamification poses as a pathway to support the transition to a sustainable society. Through its inherently motivating nature, gamification is relevant for raising engagement and encouraging sustainable actions, even for those who are disengaged with sustainability issues.

Both game-based approaches are relevant to the sustainability activities of businesses as they engage participants in different ways. While serious games can play a key role in guiding creative thinking and facilitating sustainable innovation, gamification can be used to assist in the implementation of sustainable actions. Future work could add value by focusing on the outcomes of such game-based approaches. As discussed in this chapter, it is crucial to ensure game-based approaches intended for sustainable innovation do indeed support the transformation to a more sustainable society.

References

Abt, Clark C. 1987. *Serious games*. New York: University Press of America.

Age of Energy. 2016. "The Age of Energy." Last modified February 2. Accessed January 15, 2018. http://www.cityzen-smartcity.eu/home/games/the-age-of-energy/.

Allcott, Hunt. 2011. "Social norms and energy conservation." *Journal of Public Economics* 95 (9): 1082–95. https://doi.org/10.1016/j.jpubeco.2011.03.003.

Ayres, Ian, Sophie Raseman, and Alice Shih. 2009. "Evidence from two large field experiments that peer comparison feedback can reduce residential energy usage." *NBER Working Paper Series*. Accessed April 20, 2018. http://www.nber.org/papers/w15386.pdf.

Baylis, John, Patricia Owens, and Steve Smith. 2014. *The globalization of world politics: An introduction to international relations*, 6th ed. Oxford: Oxford University Press.

Bocken, N. M. P., S. W. Short, P. Rana, and S. Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56. https://dx.doi.org/10.1016/j.jclepro.2013.11.039.

Bocken, Nancy M. P., Samuel W. Short, Padmakshi Rana, and Steven A. Evans. 2013. "A value mapping tool for sustainable business modelling." *Corporate Governance* 13 (5): 482–97. Accessed March 31, 2016. https://doi.org/10.1108/CG-06-2013-0078.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19. https://doi.org/10.1016/j.jclepro.2012.07.007. Accessed December 5, 2017.

Caballero-Hernández, Juan Antonio, Manuel Palomo-Duarte, and Juan Manuel Dodero. 2017. "Skill assessment in learning experiences based on serious games: A systematic mapping study." *Computers & Education* 113: 42–60. Accessed January 11, 2018. https://doi.org/10.1016/j.compedu.2017.05.008.

Centre for Systems Solutions. 2018. "Centre for systems solutions." Accessed April 19, 2018. https://systemssolutions.org/.

Connolly, Thomas M., Ewan MacArthur, Mark Stansfield, and Evelyn McLellan. 2007. "A quasi-experimental study of three online learning courses in computing." *Computers & Education* 49 (2): 345–59. https://doi.org/10.1016/j.compedu.2005.09.001.

Cordova, Diana I., and Mark R. Lepper. 1996. "Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice." *Journal of Educational Psychology* 88 (4): 715–30. https://doi.org/10.1037/0022-0663.88.4.715.

Dahlin, Jon Erik. 2018. "Dilemma: A board game for teaching sustainable development." Accessed April 19, 2018. http://www.jonerikdahlin.com/dilemma/.

Despeisse, Mélanie, and Peter Lunt. 2017. "Teaching energy efficiency in manufacturing using gamification: A case study." In *Advances in production management systems. The path to intelligent, collaborative and sustainable manufacturing*, edited by Hermann Lödding, Ralph Riedel, Klaus-Dieter Thoben, Gregor von Cieminski, and Dimitris Kiritsis, 419–26. Cham: Springer.

DeWulf, Kristel R. 2010. "Play it forward: A game-based tool for sustainable product and business model innovation in the fuzzy front end." Paper presented at the knowledge collaboration & learning for sustainable innovation: 14th European Roundtable on Sustainable Consumption and Production (ERSCP) conference/the 6th Environmental Management for Sustainable Universities (EMSU) conference, Delft, The Netherlands, October 25–29.

Fernández Sánchez, Paloma 2018. "Educational use of games versus gamification." Presentation presented at the international materials education symposium, Cambridge, UK, April 12–13.

Fishbanks. 2018. "Fishbanks: A renewable resource management simulation." Accessed April 17, 2018. https://mitsloan.mit.edu/LearningEdge/simulations/fishbanks/Pages/fish-banks.aspx.

Fox, Zoe. 2011. "'Trash Tycoon' brings eco-responsibility to social gaming." Last modified September 9, 2011. Accessed April 21, 2018. https://mashable.com/2011/09/09/trash-tycoon-social-gaming/-f2bm1l.9Pkqs.

Freeman, R. Edward, and Daniel R. Gilbert. 1992. "Corporate strategy and the search for ethics." *Journal of Business Ethics* 11 (7): 514–54.

Froehlich, Jon. 2015. "Gamifying green: Gamification and environmental sustainability." In *The gameful world*, edited by Steffen P. Walz and Sebastian Deterding. London: UK: MIT Press. Accessed April 17, 2018. https://www.cs.umd.edu/~jonf/publications/Froehlich_GamifyingGreen_EarlyDraft-22000words_GamefulWorldBook.pdf.

Fullerton, Tracy, and Christopher Swain. 2008. "Chapter 2—The structure of games." In *Game design workshop*, 2nd ed., 26–48. Boston: Morgan Kaufmann.

Garris, Rosemary, Robert Ahlers, and James E. Driskell. 2002. "Games, motivation, and learning: A research and practice model." *Simulation & Gaming* 33 (4): 441–67. Accessed April 23, 2018. https://doi.org/10.1177/1046878102238607.

Hansen, Erik G., and Stefan Schaltegger. 2016. "The sustainability balanced scorecard: A systematic review of architectures." *Journal of Business Ethics* 133 (2): 193–221. https://doi.org/10.1007/s10551-014-2340-3.

Johnson, Mark W., and Josh Suskewicz. 2009. " How to jump-start the clean tech economy." *Harvard Business Review* 87 (11): 50–59. Accessed January 4, 2018. https://hbr.org/2009/11/how-to-jump-start-the-clean-tech-economy.

Kasurinen, Jussi, and Antti Knutas. 2018. "Publication trends in gamification: A systematic mapping study." *Computer Science Review* 27: 33–44. https://doi.org/10.1016/j.cosrev.2017.10.003.

Ke, Fengfeng. 2009. "A qualitative meta-analysis of computer games as learning tools." In *Handbook of research on effective electronic gaming in education*, edited by Richard E. Ferdig, 1–31. Kent, OH: Kent State University; Hershey, PA: IGI Global. Accessed January 14, 2018. http://kanagawa.lti.cs.cmu.edu/11780/sites/default/files/GameSurvey1.pdf.

Kolb, Alice Y., and David A. Kolb. 2005. "Learning styles and learning spaces: Enhancing experiential learning in higher education." *Academy of Management Learning & Education* 4 (2): 193–212.

Laurischkat, Katja, and Arne Viertelhausen. 2017. "Business model gaming: A game-based methodology for E-mobility business model innovation."

Procedia CIRP 64: 115–20. Accessed January 4, 2018. https://doi.org/10.1016/j.procir.2017.03.051.

Lee, Tien Ming, Ezra M. Markowitz, Peter D. Howe, Chia-Ying Ko, and Anthony A. Leiserowitz. 2015. "Predictors of public climate change awareness and risk perception around the world." *Nature Climate Change* 5: 1014. Accessed January 10, 2018. https://dx.doi.org/10.1038/nclimate2728.

Linder, Marcus, and Mats Williander. 2015. "Circular business model innovation: Inherent uncertainties." *Business Strategy and the Environment*. https://doi.org/10.1002/bse.1906.

Madani, Kaveh, Tyler W. Pierce, and Ali Mirchi. 2017. "Serious games on environmental management." *Sustainable Cities and Society* 29: 1–11. Accessed January 4, 2018. https://doi.org/10.1016/j.scs.2016.11.007.

Michael, David R., and Sande Chen. 2006. *Serious games: Games that educate, train and inform*. Boston, MA: Thomson Course Technology.

Osterwalder, Alexander, and Yves Pigneur. 2010. *Business model generation: A handbook for visionaries, game changers, and challengers*. Hoboken, NJ: Wiley.

Osterwalder, Alexander, Yves Pigneur, and Christopher L. Tucci. 2005. "Clarifying business models: Origins, present, and future of the concept." *Communications of the Association for Information Systems* 15 (1): 1–25. Accessed December 2, 2018. http://aisel.aisnet.org/cgi/viewcontent.cgi?article=3016&context=cais.

Owen, Paula. 2017. *How gamification can help your business engage in sustainability*. New York: Routledge.

Recyclebank. 2017. "Recyclebank." Accessed January 11, 2018. https://www.recyclebank.com/about-us/.

Sadowski, Jathan, Thomas P. Seager, Evan Selinger, Susan G. Spierre, and Kyle P. Whyte. 2013. "An experiential, game-theoretic pedagogy for sustainability ethics." *Science and Engineering Ethics* 19 (3): 1323–39. https://doi.org/10.1007/s11948-012-9385-4.

Schaltegger, Stefan, Erik G. Hansen, and Florian Lüdeke-Freund. 2016. "Business models for sustainability: Origins, present research, and future avenues." *Organization & Environment* 29 (1): 3–10. https://doi.org/10.1177/1086026615599806.

Schnelle, John F., M. Patrick McNees, Murphy M. Thomas, John G. Gendrich, and Gwen P. Beagle. 1980. "Prompting behavior change in the community: Use of mass media techniques." *Environment and Behavior* 12 (2): 157–66. Accessed April 21, 2018. https://doi.org/10.1177/0013916580122002.

Siegal, Jacob. 2017. "Four out of five 'Pokemon Go' users have quit." Last modified April 3, 2017. Accessed April 21, 2018.

Sitzmann, Traci. 2011. "A meta-analytic examination of the instructional effectiveness of computer-based simulation games." *Personnel Psychology* 64 (2): 489–528. https://doi.org/10.1111/j.1744-6570.2011.01190.x.

Stillwater, Tai, and Kenneth Kurani. 2011. "Field test of energy information feedback." *Transportation Research Record: Journal of the Transportation Research Board* 2252: 7–15. https://doi.org/10.3141/2252-02.

Stubbs, Wendy, and Chris Cocklin. 2008. "Conceptualizing a 'sustainability business model'." *Organization and Environment* 21 (2): 103–27. https://doi.org/10.1177/1086026608318042.

Turkay, Selen, and Sonam Adinolf. 2010. "Free to be me: A survey study on customization with World of Warcraft and City Of Heroes/Villains players." *Procedia—Social and Behavioral Sciences* 2 (2): 1840–45. https://doi.org/10.1016/j.sbspro.2010.03.995.

Turkay, Selen, and Sonam Adinolf. 2015. *The effects of customization on motivation in an extended study with a massively multiplayer online roleplaying game*. Vol. 9.

TwoGo. 2017. "TwoGo." Accessed January 11, 2018. https://www.twogo.com/de.

Tycoon, Trash. 2012. "Trash Tycoon." Last modified July 7, 2012. Accessed April 21, 2018. https://www.facebook.com/trashtycoon/.

Visch, Valentijn, Niko Vegt, Hester Anderiesen, and Katinka Van der Kooij. 2013. "Persuasive game design: A model and its definitions." Paper presented at CHI 2013: Workshop designing gamification: Creating gameful and playful experiences, Paris, France, April 27–May 2.

Wang, Hua, Cuihua Shen, and Ute Ritterfeld. 2009. "Enjoyment of digital games what makes them 'seriously' fun?" In *Serious games: Mechanisms and effects*, edited by Ute Ritterfeld, Michael Cody, and Peter Vorderer, 25–46. Hoboken: Taylor and Francis.

Watt, James H. 2009. "Improving methodology in serious games research with elaborated theory." In *Serious games: Mechanisms and effects*, edited by Ute Ritterfeld, Michael Cody, and Peter Vorderer, 373–88. Hoboken: Taylor & Francis.

Whalen, Katherine. 2017. "Risk & race: Creation of a finance-focused circular economy serious game." In *Product lifetimes and the environment*, edited by C. A. Bakker and R. Mugge, 422–25. Delft, The Netherlands: IOS Press Ebooks.

Whalen, Katherine., Cecilia Berlin, Johanna Ekberg, Ilaria Barletta, and Peter Hammersberg. 2018. "'All they do is win': Lessons learned from use of a serious game for circular economy education." *Resources, Conservation and Recycling*. http://dx.doi.org/10.1016/j.resconrec.2017.06.021.

Witmer, Jill F., and E. Scott Geller. 1976. "Facilitating paper recycling: Effects of prompts, raffles, and contests." *Journal of Applied Behavior Analysis* 9 (3): 315–22. https://doi.org/10.1901/jaba.1976.9-315.

Zott, Christoph, and Raphael Amit. 2010. "Business model design: An activity system perspective." *Long Range Planning* 43 (2–3): 216–26. https://doi.org/10.1016/j.lrp.2009.07.004.

21

Circular Economy Inspired Imaginaries for Sustainable Innovations

Rumy Narayan and Annika Tidström

Introduction

The Circular Economy (CE) has attracted a lot of attention in policy and business, where it is viewed as an important approach for achieving sustainable development. The CE-concept has its roots in historical, economic, and ecological fields, which highlights its relevance to sustainable business (Murray et al. 2017). Geissdoerfer et al. (2017: 759) have defined CE as: "as a regenerative system in which resource input and waste, emission, and energy leakage are minimised by slowing, closing, and narrowing material and energy loops".

CE, therefore, provides impetus for a new economic system with multiple opportunities for innovation (Korhonen et al. 2018; Geissdoerfer

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et al. 2017; Bocken et al. 2016; Ghisellini et al. 2016; Brennan et al. 2015). Innovations hold the keys to sustainable development and sustainable innovation implies 'a collective commitment of care for the future through responsible stewardship of science and innovation in the present' (Owen et al. 2013). Innovation consequently involves complex interactions between organizations, technologies, and industry sectors (Rip 2012; Van de Ven et al. 2008; Abernathy and Clark 1985).

As a critical dimension of policymaking, innovation draws attention to the imaginations that are associated with it, in terms of unanticipated risks, uncertainties, ambiguities, social fragility, and so on (Pfotenhauer and Jasanoff 2017; Jasanoff 2006; Sturken et al. 2004; Beck and Ritter 1992). However, there is also a performative function associated with these imaginations that explore how innovations are realised through 'sociology of expectations' (Pfotenhauer and Jasanoff 2017). Imaginaries capture and influence ideas, symbols, and feelings. In doing so, imaginaries help in producing a shared sense of belonging to guide the collective understanding of our world (Jasanoff and Kim 2009). They contribute to the emergence of new social and technological configurations for future-oriented businesses with promises of innovation opportunities that do not exist except in the imaginaries of involved actors (Borup et al. 2006).

Jasanoff and Kim (2009: 120) have defined such sociotechnical imaginaries as "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects". They are frequently used to elucidate the "hidden social dimensions of energy systems", as they represent important "cultural resources that shape social responses to innovation" (Jasanoff and Kim 2013: 189–190). The CE with its focus on reformulating our relationship with materials and goods (Stahel 2016) through innovations embodies certain sociotechnical imaginaries.

Sociotechnical imaginaries define and shape the understanding of innovations from diverse perspectives and play an important role in mobilising the required resources. Sociotechnical imaginaries, therefore, are descriptions of futures that are attainable and offer prescriptive means through which such futures could be attained (Jasanoff and Kim 2009). Sociotechnical imaginaries are visions that involve the creation of shared sociotechnical futures through innovations. Such imaginaries provide 'a thread of continuity and stability by extending existing frames of reference from the past into the future, thus mitigating the unknown through what is known and taming the disruptive quality of innovation through what is imaginable and permissible in a given social, political, and historical context' (Pfotenhauer and Jasanoff 2017: 788).

For sustainable innovation, the frame expands from traditional objectives such as economic growth, to those related to societal needs related to reducing inequality, and promoting sustainable production and consumption systems. Merli et al. (2017) have recently urged for research on CE to focus on societal changes required for global transition paths towards sustainable production and consumption systems. However, these new framings do not replace the existing ones, rather, framings compete with one another for the imagination of various stakeholders (Schot and Steinmueller 2016).

The challenge is to figure out the kind of actions that could direct innovations for tackling such system-wide transformations. Here, public organisations play an important role (Mazzucato 2015, 2016). These organisations act as intermediaries for facilitating the collective creation of imaginaries for innovations. Further, public organisations need to steer and evaluate dynamic change and encourage an experimental process of innovative change (Edmondson et al. 2018; Schot and Steinmueller 2016; Mazzucato 2013).

The aim of this chapter is to explore how CE-inspired sociotechnical imaginaries, through collaboration and values, facilitate sustainable innovation. The empirical part of the chapter is based on a qualitative case study of Sitra, the Finnish innovation agency, and how it inspires imaginaries for sustainable innovation through CE. The CE is emerging as a socio-economic paradigm that could open ways for innovative and sustainable means of production and consumption; studies into the social implication of this remain insufficient (Merli et al. 2017). This chapter sheds new light on how CE, in addition to implying a particular mode of production and consumption, could also prioritise societal elements that enable sustainable innovation.

Below we present a review of sustainable innovations, imaginaries, and intermediaries. Thereafter, the methodology is described, followed by a presentation and discussions of findings of the empirical study. The chapter ends with some conclusions including implications for theory and practice.

Literature Review

Sustainable Innovations

While innovation is widely recognised as essential for addressing complex sustainability-related issues, the current innovation frames and approaches may not be suitable for solving these issues (Adams et al. 2016; Boons and Lüdeke-Freund 2013; Soete 2013). For instance, innovation in consumer products might have directed our societies towards "a long-term conspicuous consumption path of innovation" that destroys the value of the product forcing consumers to buy more frequently (Soete 2012: 9). For the desired transformative change, the focus of innovation needs to shift towards achievement of system-wide transformation from mere optimisation of existing systems related to products and processes (Adams et al. 2016; OECD 2015).

Sustainability-oriented innovations require intentional changes in firms' philosophy and values (Adams et al. 2016). This implies systemic innovations aimed at transforming existing societal relationships, interactions between firms, user behaviours and lifestyles, institutional orientations, and business objectives (Adams et al. 2016; Draper 2013). Sustainable innovations should ultimately be able to address the economic challenges associated with deregulated markets and skewed incentive structures leading to recurring financial and economic turbulence (Jackson 2016; Sachs 2015). Moreover, sustainable innovation should consider societal issues related to inferior quality of work and life, and high levels of inequality (Piketty and Zucman 2014; Stiglitz 2012; Banerjee and Duflo 2011; Sen 2001). Sustainable innovation initiatives should also address environmental problems that are endangering our natural systems (Jackson 2016; Steffen et al. 2015; Meadows et al. 1972).

Firms play a central role for sustainable innovations, as they are a part of both the problem and the solution; they reinforce the current economic paradigm, thus, they may influence positive change towards sustainability (Adams et al. 2016). In practice, innovations in domains like new business models replacing products with services that offer alternatives indicate that the focus should extend beyond the technology, to include how innovations are used, who they involve, and how they affect behaviour change (Geels 2004). By extending the frame to include sustainability, the complexity multiplies, and to facilitate the transition process, creating imaginaries becomes an effective tool.

Sociotechnical Imaginaries

Originally defined by Jasanoff and Kim (2009) as 'collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects', sociotechnical imaginaries emphasise action and performance along with materialisation through technology. This involves developing capabilities for envisioning future scenarios that enable a shared understanding of the social and technical aspects of innovation and their implicated futures. These futures entail new configurations of technologies, markets, user practices, policies, and cultural discourses implying new sociotechnical imaginaries.

CE is related to sociotechnical imaginaries as it draws on an inheritance from fields like industrial ecology (Bocken et al. 2016; Clift and Druckman 2015; Gregson et al. 2015), 'cradle-to-cradle' design (McDonough and Braungart 2010), and 'natural capitalism' (Lovins et al. 1999), offering new ways of imagining our sociotechnical systems. In these 'sociotechnical imaginaries', the concept of waste would become redundant (MacArthur 2013) through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling (Bocken et al. 2016). For instance, by offering a novel perspective on waste and resource management and a new cognitive unit and discursive space for debate, CE enables the alignment of decisions and actions on technologies and appropriate organisational structures to support them (Bocken et al. 2017; Blomsma and Brennan 2017). The transformation in practices like design and reuse, with the objective of keeping materials in circulation through a series of systemic feedback loops (Hobson 2016; Stahel 2016; Bocken et al. 2014; MacArthur 2013) creates a powerful incentive for attracting businesses towards CE.

The core idea of CE is driven by a vision of future opportunities for building profitable businesses through innovations that highlight resource efficiency, implying an economic and environmental focus (Murray et al. 2017; Ghisellini et al. 2016; Preston 2012). Such innovations impact how we think about life, as how we make things dictates how we work, what we buy, and how we conduct our lives (Preston 2012). In discussing CE models, there is a fundamental change in how the future is imagined. However, recent studies have also indicated that so far action on CE is largely limited to recycling and cleaner production (Merli et al. 2017) and reuse faces cognitive barriers (Ranta et al. 2018). In CE contexts, enabling sociotechnical imaginaries could offer a way forward, as unlike narratives, they are explanatory and used for justification purposes. They could offer hypothetical futures and the resources and capabilities needed to make them concrete.

As sociotechnical imaginaries are intricately entwined with how institutions and economic activities are organised and structured, they influence the ways in which people think they ought to be organised and structured (Anderson 2006; Taylor 2004). Firms are embedded in a certain culture and environment that shapes their symbols, norms, and meanings, and it is pragmatic to connect with them from within "the direct practice of social life" (Dewey and Boydston 1925, as cited by Scherer and Palazzo 2007, in Alfred and Adam 2009). For firms sustainability matters mainly because of the growing societal expectation that they must use resources and materials responsibly and wisely, reduce pollution and toxins in production and consumption processes, and address issues related to climate change (Ehrenfeld 1999; Alfred and Adam 2009).

Sociotechnical imaginaries could describe possible futures that incorporate these while prescribing how to attain them. Such imaginaries exert substantial influence on contemporary politics and shape discourses that determine economic, technical, and social trajectories (Jasanoff 2006). The concept of sociotechnical imaginaries is used to understand how national science and technology (S&T) projects evolve over time. Policies on S&T have been described as arenas for capturing the role of culture and practices that enable the creation and stabilisation of particular imaginaries that influence future pathways (Jasanoff and Kim 2009). For instance, leasing as a CE business model would entail new ways of imagining ownership and lifestyles while developing capabilities for services, supporting technologies, lasting design, and existing policy frameworks that are currently attuned towards linear models. This is similar to sustainable innovation process arenas that are systemic and complex, involving interactions between diverse groups of actors—producers, users, entrepreneurs, early adopters, idea generators, policymakers, and financiers. It also brings into focus the importance of intermediaries.

Transition Intermediaries

Transition intermediaries are actors that facilitate coordination processes during complex transition processes involving industry, policymakers, research organisations, and other stakeholders (van Lente et al. 2003). Intermediaries could take various organisational forms, for instance, intermediaries that facilitate transitions to renewable energy have often been government agencies and organisations, NGOs (non-governmental organisations), public utilities and consultancies, including private energy service companies (ESCs) (Backhaus 2010). Intermediaries understand the implied changes in sociotechnical systems, characterised by shifts in infrastructures, actor groups, technologies and contexts of application (Moss 2009; van Lente et al. 2003).

Intermediary organisations intercede within existing systems of production and consumption to create and encourage competing debates and narratives while influencing underlying social interests during transition processes (Hamann and April 2013; Hodson and Marvin 2010; Seitanidi and Lindgreen 2010). As sustainability transition processes have gained momentum, the roles played by intermediaries that aid these processes have come into focus (Kivimaa et al. 2017; Kivimaa 2014). Intermediaries play an important role in the selection of the kinds of innovations that are given prominence, the way they are framed, and the process through which they are finally embedded within society.

The interconnectedness of sustainability issues demands innovations to be conceptualised through sociotechnical imaginaries that leverage the societal dynamics to create a link with what is desirable, with the help of intermediaries.

Methodology

The empirical study is based on qualitative single case study research, which was considered as most appropriate as the aim was to get rich and in-depth information about a previously unexplored phenomenon (Eisenhardt 1989). The chosen case is Sitra, the Finnish Innovation Fund, an independent public foundation, which operates directly under the supervision of the Finnish Parliament. It was purposefully selected, as it is a key organisation that is building an understanding of current societal transitions and facilitating the ways and means of generating discussions and debates on pathways for such transition processes. Sustainability is an integral part of its agenda and it has identified CE as a key approach for inspiring sustainable innovations.

The applied research methods were interviews and written documents. In total, seven semi-structured interviews have been carried out in June and September 2017. The average length of an interview was 35–40 minutes. The informants were considered as most appropriate as they have important and influential roles related to Sitra's CE initiative. The written material was collected from various sessions during the World Circular Economy Forum (WCEF) hosted by Sitra in June 2017, this included presentations as well as panel discussions.

This study used the grounded theory approach (Jørgensen 2001; Strauss and Corbin 1994), as at its core, it involved studying a social process. This approach helped in identifying how the CE creates sociotechnical imaginaries or visions for hypothetical futures that could enable pathways for sustainable innovation.

Findings

There are two main findings from this study. The first relates to the role of sociotechnical imaginaries in prompting a collective process of meaning making for negotiating collaborative paths for sustainable innovation. The second finding is related to the importance of sociotechnical imaginaries in leveraging national shared culture to develop visions for sustainable innovations.

Imaginaries for Collective Meaning Making

Our findings indicate that Sitra's initiatives related to CE-inspired sociotechnical imaginaries for businesses of the future act as an incentive for firms to get involved. Initially, they revolve around activities that appear possible within the existing system of production and consumption. Models around recycling, repair and maintenance are strong drivers as firms are able to visualise solutions within their current operations. However, during the workshops organised by Sitra, it became evident that while exploring practical pathways for operationalising these models, actors encounter the challenges underlying such models. These challenges include activities such as new logistics design, identifying new partners, reorienting firm objectives, and designing innovative consumer engagement initiatives. In recognising these challenges, the actors begin focusing on the specific values attached to collaboration and sharing. For instance, both collaboration and sharing enable firms to distribute risks and responsibilities, scale-up activities like logistics, material use, design, training, and make them economically viable. Thus, CE models allow for a shared understanding of contexts highlighting the values that shape future imaginaries.

The imaginaries inspired by CE are comprised of loops where the consumption and production processes result in little or no waste. During a CE conference organised by Sitra, we observed a gradual progress in understanding the application of imaginaries, as actors expanded their understanding of CE models through increased levels of interaction with these imaginaries. The pathways for the transition to CE models of repair, refurbish, recycle, renting, sharing, borrowing, and redesigning, trigger imaginaries that have wider implications. These implications are related to a deeper engagement with needs through a combination of products and services, which calls for meaningful relationships with the customer. Developing such relationships require proximity and our findings indicate that relating the CE models to the core social and cultural values of the participants enables this proximity. For instance, the participants' shared understanding of trust and collaboration along with an identification with societal values, within their common social and cultural contexts made it easier to build connections. Our findings show that the values strengthen the ties between actors and enable them to negotiate pathways for production and consumption systems through innovations that seek to address the economic, social, and environmental dimensions.

At the Sitra conference, we observed how CE models enable firms to visualise waste as a resource, and in trying to make sense of the practical implications of such visualisation, firms invoke not just the material and organisational resources that need to be deployed, but also imaginative resources. Imaginative resources are the ideas and thoughts that are invoked by the actors trying to make the transition from the current linear system towards a circular one. The imaginative resources help in relating the goals, priorities, benefits, and risks to the firms, as well as the societal frameworks they are embedded in.

Pursuing the operational aspects of CE models result in deeper understanding of the underlying issues that constrain sustainability pathways, for instance, existing societal relationships, business objectives, behaviours and lifestyles, and institutional set ups. They also trigger a collective process of imagining change. These imaginaries are able to expand the values associated with collaboration and sharing to transparency and trust. It became evident that while collaboration and sharing are important for operationalising CE models, transparency and trust form the basis of building those values. In operationalising CE visions, the opportunities for business and innovations become linked to certain societal values. For instance, developing sustainable packaging through collaboration distributes the cost of development and builds scale, but it also forces firms to confront their existing principles regarding opening up parts of their business processes to outsiders. We observed how these realisations led to further discussions on the importance of values like trust and transparency in Finnish society.

Sitra brings together a wide range of stakeholders from and diffuses the ideas related to CE in order to encourage interactions for a rich social construction of what it means for different people. In practice, this happened by engaging actors in workshops and at a conference. The CE pathways are co-produced during the interactions. The interactions resulted in creating specific relationships to issues and the meanings attached to them, to build an understanding of the kinds of innovations that are acceptable. Environmental issues, for instance, resonate because of the ways in which various actors describe their relationship with nature—as an important common resource, a source for various economic activities and enriching social experiences involving family and friends. The focus then shifts to the kind of innovations that would incorporate these objectives without privileging one over the other. Through this process, the interrelatedness of the environmental, economic, and social elements becomes evident.

Imaginaries Rooted in Culture

The interviews with Sitra and interactions with other actors during the conference indicated that in Finland, there appears to be a strong identification with innovations and a certain pride in technological prowess. This coupled with a deep cultural tradition of making and fixing things makes CE emotionally and intellectually engaging and practically appealing. Such culturally specific imaginaries of innovation become productive means of engagement, as they resonate with the ideas underlying CE.

Through CE, Sitra is inspiring collective sociotechnical imaginaries through a shared national culture of building world-class organisations, exploring entrepreneurial opportunities, and leading to new job creation and skill development. The idea of a national first mover advantage acts as a key motivating factor. The appeal of acquiring a knowledge-based competitive advantage is strong and actors believe that CE models could, through opportunities for sustainable innovations,

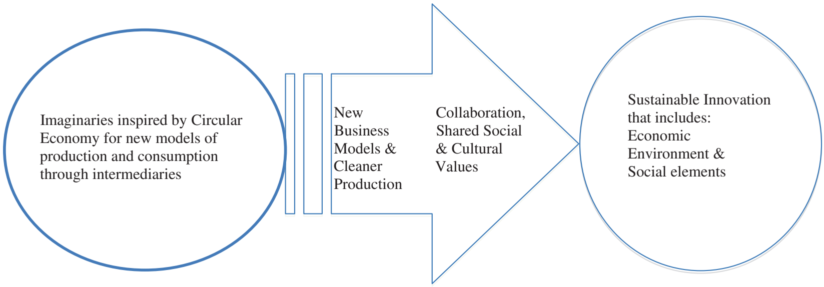

Fig. 21.1 From CE-inspired imaginaries to sustainable innovations

enable that. There is a shared understanding that these experiences would serve as learning guides for future transition processes. The understanding and the consequent identification of innovation opportunities are within a certain cultural context. Here, innovations are seen as a collectively imagined sociotechnical progress for Finnish society while acknowledging the problems they are expected to solve. We find that Sitra is employing CE to inspire a culturally constructed understanding of sustainability.

Sitra employed CE to create an experience of innovation processes and what they can mean to diverse groups of people by invoking a shared national culture. Initially, by creating a set of imaginaries to generate engagement processes, followed by the creation of CE platforms for sustainable food, forest-based loops, technical loops, transport logistics, and a platform for common action for facilitating system-wide transition processes.

The key findings of the empirical study are illustrated in Fig. 21.1.

Discussion

For CE, sociotechnical imaginaries offer an approach that enable processes of continuous engagement between the dynamics of innovations within their social and cultural contexts. Innovations are increasingly coming under the purview of practitioners, with diverse groups of actors engaging in doing, implementing, or fostering them

(Pfotenhauer and Jasanoff 2017). As CE gains relevance, the sociotechnical imaginaries associated with it open up pathways for exploring related innovations while engaging with the social and cultural meanings attached to them. Businesses and policymakers often view elements of innovation as something that can be identified and standardised across markets but in practice, many of these elements need to be pegged to particular contexts and sociotechnical imaginaries offers the means for doing so. For academics and researchers, they offer new ways of understanding innovation processes and capturing the connections and interrelatedness of such processes, to see what works and what does not, and why.

Existing studies on CE are mainly focused on resource management and environmental practices, while those intending to reshape the socio-economic paradigm are rare. When linking CE to the broader aspect of sustainability, there is often a failure to fully recognise the implications from social science perspectives (Merli et al. 2017; Murray et al. 2017). Our findings indicate that the sociotechnical imaginaries connected to CE can leverage national shared culture and play an important role in facilitating pathways for sustainable innovation opportunities. Imagination as 'an organised field of social practices' (Jasanoff and Kim 2009: 122) plays an important role in creating social order. In this case, the national shared culture of making and fixing things and deriving pride from national innovation and technological projects provide the social cues for creating sociotechnical imaginaries for CE, and in doing so, open up possibilities for sustainable innovation. These findings gain relevance because they add a new and interesting dimension to research on CE and its implications of sustainable innovation.

From the perspective of firms and policymakers, driving sustainable consumption and production is considered an essential strategy for achieving CE (Bilitewski 2012) and the related activities are frequently connected to waste management (Pauliuk 2018; Sakai et al. 2017). However, there is a need for strategies that can transform the upstream process of production and consumption (Bocken et al. 2017). Invoking sociotechnical imaginaries through CE is one such strategy that lets actors devise their own understanding of how practices related to production and consumption could evolve and what they imply.

The complexities inherent in sustainability challenges are difficult to address within our often-disconnected worlds of business and consumers, on one hand, and governmental policy and economic advice on the other (Grubb et al. 2014). We find that invoking sociotechnical imaginaries through CE acts as a bridging mechanism between various actors. The dominant perspectives on CE offer pathways that present a positive correlation between economic potential and sustainability goals, in terms of pursuing economic growth by focusing on environmental issues and resource scarcity (Merli et al. 2017). Our findings show how these pathways are driven by existing realities of the actors involved. They relate to economic growth powered by innovations as an important driver for action. The CE offers tangible ways in visualising these realities by addressing costs related to resource scarcity and product waste. Highlighting the economic potential generates interest and encourages participation in exploring ideas on CE, as do the standardised tools and methods that guide the transition process towards mitigating environmental impact (Merli et al. 2017). However, supporting CE models like repair, reuse, and renting, implies shifts in sociotechnical imaginaries relating to use, practices, traditions, identity, behaviour, and relationships. These imaginaries add a third vital pillar (the other two being economic and environmental) to CE oriented innovations, and that is, the social dimension. Our findings illustrate how sociotechnical imaginaries inspired by CE unveil the practical pathways for businesses to embark on sustainability journeys through innovations.

Social imaginaries are informed by people's understanding of their social existence, in terms of how they interact with each other; what goes on between them in order to fit existing norms and develop new ones to meet changing expectations (Jasanoff 2015; Taylor 2004). We explore how CE-inspired imaginaries are constructed through shared cultural values that are effective in drawing attention to what is meaningful and important, within a certain community of people, for creating the connections and collaborations needed for change. This change is characterised by a shift in the ways of doing things (practices) within existing norms. However, the shift is not easy, as the incumbent system's deep entrenchment makes it resistant to change (Unruh 2000). The evidence for this can be observed, for instance, in the lack of studies that investigate how firms may integrate CE principles into their business practices (Merli et al. 2017; Manninen et al. 2018) or the continuing focus on 'traditional' cleaner production business practices (Merli et al. 2017). Therefore, studies highlighting social interactions are important. Our study contributes here by showing that sociotechnical imaginaries offered by CE shape the ideas that help in realising sustainable innovation.

Innovations characterise business transitions to sustainability and CE presents opportunities for such innovations by offering perspectives on waste and resource management through cognitive and discursive spaces for debate, for aligning decisions and actions on technologies and organisational structures (Bocken et al. 2017; Blomsma and Brennan 2017). However, the findings of our study show that sustainable innovation cannot be captured in models or best practices alone. Such innovations are deeply rooted in specific social, cultural, political, and economic contexts.

Conclusion

The main conclusion of this chapter is that CE has the ability for triggering imaginaries resulting in actions that could facilitate sustainable innovation processes. From a theoretical perspective, this leads to an understanding of the social engagements necessary for operationalising CE models in order to make them sustainable.

For managers, engaging with sociotechnical imaginaries could reveal the shared meanings and values attached to the practical implementation of CE models, thus highlighting the significance of social elements of CE. For instance, collaborating with diverse actors highlight the relevance of both cultural values and social practices for facilitating sustainable innovation processes. Sociotechnical imaginaries have material outcomes in terms of influencing behaviour and narratives as well as feelings of individual and collective identities. Therefore, they could be useful tools for practitioners and policymakers who often find it difficult to qualify what sustainability entails. They can also influence the development of policy and institutions, and concepts like CE help policymakers to initiate diverse actors to interact with each other. Letting such sociotechnical imaginaries emerge through processes of societal interactions could enable the intentional changes required to orient innovations towards sustainability. Therefore, the role of intermediaries that create spaces for building collective purpose and collaboration opportunities is important.

An avenue for future research could be to explore the capabilities of intermediaries in different sustainable innovation contexts. There is also a need for more research exploring the possibility of building a model for creating imaginaries that enable innovations to move from the traditional technical focus to one of changing behaviours. In this context, it would also be interesting to explore the idea of storytelling as a method of system building for sustainable innovation. The strategic value of storytelling for sustainable innovation lies in their ability to build connections between people, ideas, and activities for transformational change.

References

Abernathy, William J., and Kim B. Clark. 1985. "Innovation: Mapping the winds of creative destruction." *Research Policy* 14 (1): 3–22.

Adams, Richard, Sally Jeanrenaud, John Bessant, David Denyer, and Patrick Overy. 2016. "Sustainability-oriented innovation: A systematic review." *International Journal of Management Reviews* 18 (2): 180–205.

Alfred, A. Marcus, and R. Fremeth Adam. 2009. "Green management matters regardless." *The Academy of Management Perspectives* 23 (3): 17–26.

Anderson, Benedict. 2006. "Imagined communities (New ed.)." New York and London: Verso.

Backhaus, Julia. 2010. "Intermediaries as innovating actors in the transition to a sustainable energy system." *Central European Journal of Public Policy* 4 (1): 86–108.

Banerjee, Abhijit V., and Esther Duflo. 2011. *Poor economics: A radical rethinking of the way to fight global poverty*. New York: PublicAffairs.

Beck, Ulrich, and Mark Ritter. 1992. *Risk society: Towards a new modernity*. London: Sage Publications.

Bilitewski, Bernd. 2012. "The circular economy and its risks." *Waste Management* 32 (1): 1.

Blomsma, Fenna, and Geraldine Brennan. 2017. "The emergence of circular economy: A new framing around prolonging resource productivity." *Journal of Industrial Ecology* 21 (3): 603–14.

Bocken, Nancy M. P., Elsa A. Olivetti, Jonathan M. Cullen, José Potting, and Reid Lifset. 2017. "Taking the circularity to the next level: A special issue on the circular economy." *Journal of Industrial Ecology* 21 (3): 476–82.

Bocken, Nancy M. P., Ingrid de Pauw, Conny Bakker, and Bram van der Grinten. 2016. "Product design and business model strategies for a circular economy." *Journal of Industrial and Production Engineering* 33 (5): 308–20.

Bocken, Nancy M. P., Paavo Ritala, and Pontus Huotari. 2017. "The circular economy: Exploring the introduction of the concept among S&P 500 firms." *Journal of Industrial Ecology* 21 (3): 487–90.

Bocken, Nancy M. P., Samuel W. Short, P. Rana, and Steve Evans. 2014. "A literature and practice review to develop sustainable business model archetypes." *Journal of Cleaner Production* 65: 42–56.

Boons, Frank, and Florian Lüdeke-Freund. 2013. "Business models for sustainable innovation: State-of-the-art and steps towards a research agenda." *Journal of Cleaner Production* 45: 9–19.

Borup, Mads, Nik Brown, Kornelia Konrad, and Harro Van Lente. 2006. "The sociology of expectations in science and technology." *Technology Analysis & Strategic Management* 18 (3–4): 285–98.

Brennan, Geraldine, Mike Tennant, and Fenna Blomsma. 2015. "Business and production solutions: Closing loops and the circular economy." In *Sustainability: Key issues*, edited by Helen Kopnina and Eleanor Shoreman-Ouimet, 219–39. Key Issues in Environment and Sustainability. Routledge: EarthScan.

Clift, Roland, and Angela Druckman, eds. 2015. *Taking stock of industrial ecology*. Cham, Switzerland: Springer International.

Dewey, John, and Jo Ann Boydston. 1925. *Experience and Nature*. The Later Works. The Collected Works of John Dewey, 1882–1953.

Draper, Stephanie. 2013. *Creating the big shift: System innovation for sustainability*. London: Forum for the Future.

Edmondson, D. L., F. Kern, and K. S. Rogge. 2018. "The co-evolution of policy mixes and socio-technical systems: Towards a conceptual framework of policy mix feedback in sustainability transitions." *Research Policy*. https://doi.org/10.1016/j.respol.2018.03.010.

Eisenhardt, Kathleen M. 1989. "Building theories from case study research." *Academy of Management Review* 14 (4): 532–50.

Ehrenfeld, John R. 1999. "Cultural structure and the challenge of sustainability." In *Better environmental decisions: Strategies for governments, businesses and communities*, edited by K. Sexton, A. A. Marcus, K. W. Easter, and T. D. Burkhardt, 223–44. Washington, DC: Island Press.

Geels, Frank W. 2004. "From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory." *Research Policy* 33 (6–7): 897–920.

Geissdoerfer, Martin, Paulo Savaget, Nancy M. P. Bocken, and Erik Jan Hultink. 2017. "The circular economy—A new sustainability paradigm?" *Journal of Cleaner Production* 143: 757–68.

Ghisellini, Patrizia, Catia Cialani, and Sergio Ulgiati. 2016. "A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems." *Journal of Cleaner Production* 114: 11–32.

Gregson, Nicky, Mike Crang, Sara Fuller, and Helen Holmes. 2015. "Interrogating the circular economy: The moral economy of resource recovery in the EU." *Economy and Society* 44 (2): 218–43.

Grubb, Michael, Jean-Charles Hourcade, and Karsten Neuhoff. 2014. *Planetary economics*. London: Routledge.

Hamann, Ralph, and Kurt April. 2013. "On the role and capabilities of collaborative intermediary organisations in urban sustainability transitions." *Journal of Cleaner Production* 50: 12–21.

Hobson, Kersty. 2016. "Closing the loop or squaring the circle? Locating generative spaces for the circular economy." *Progress in Human Geography* 40 (1): 88–104.

Hodson, Mike, and Simon Marvin. 2010. "Can cities shape socio-technical transitions and how would we know if they were?" *Research Policy* 39 (4): 477–85.

Jackson, Tim. 2016. *Prosperity without growth: Foundations for the economy of tomorrow*. London and New York: Taylor & Francis.

Jasanoff, Sheila. 2006. "Technology as site and object of politics." In *The Oxford handbook of contextual political analysis*, edited by R. E. Goodin and C. Tilly, 745–63. Oxford: Oxford University Press.

Jasanoff, Sheila. 2015. "Future imperfect: Science, technology, and the imaginations of modernity." *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*, 1–47.

Jasanoff, Sheila, and Sang-Hyun Kim. 2009. "Containing the atom: Sociotechnical imaginaries and nuclear power in the United States and South Korea." *Minerva* 47 (2): 119.

Jasanoff, Sheila, and Sang-Hyun Kim. 2013. "Sociotechnical imaginaries and national energy policies." *Science as Culture* 22 (2): 189–96.

Jørgensen, U. 2001. "Grounded theory: Methodology and theory construction." *International Encyclopedia of the Social & Behavioral Sciences* 1: 6396–99.

Kivimaa, Paula. 2014. "Government-affiliated intermediary organisations as actors in system-level transitions." *Research Policy* 43 (8): 1370–80.

Kivimaa, Paula, Wouter Boon, Sampsa Hyysalo, and Laurens Klerkx. 2017. *Toward a typology of intermediaries in transitions: A systematic review*. SPRU Working Paper Series (SWPS), 2017-17: 1–27.

Korhonen, Jouni, Cali Nuur, Andreas Feldmann, and Seyoum Eshetu Birkie. 2018. "Circular economy as an essentially contested concept." *Journal of Cleaner Production* 175: 544–52.

Lovins, Amory B., L. Hunter Lovins, and Paul Hawken. 1999. "A road map for natural capitalism." *Harvard Business Review 77*: 145–61.

MacArthur, Ellen. 2013. "Towards the circular economy." *Journal of Industrial Ecology*, 23–44.

Manninen, Kaisa, Sirkka Koskela, Riina Antikainen, Nancy Bocken, Helena Dahlbo, and Anna Aminoff. 2018. "Do circular economy business models capture intended environmental value propositions?" *Journal of Cleaner Production* 171: 413–22.

Mazzucato, Mariana. 2013. "Financing innovation: Creative destruction vs. destructive creation." *Industrial and Corporate Change* 22 (4): 851–67.

Mazzucato, Mariana. 2015. "Innovation systems: From fixing market failures to creating markets." *Revista do Serviço Público* 66 (4): 627.

Mazzucato, Mariana. 2016. "From market fixing to market-creating: A new framework for innovation policy." *Industry and Innovation* 23 (2): 140–56.

McDonough, William, and Michael Braungart. 2010. *Cradle to cradle: Remaking the way we make things*. New York: North Point Press.

Meadows, Donella H., Dennis L. Meadows, Jorgen Randers, and William W. Behrens. 1972. "The limits to growth." *New York* 102: 27.

Merli, Roberto, Michele Preziosi, and Alessia Acampora. 2017. "How do scholars approach the circular economy? A systematic literature review." *Journal of Cleaner Production* 178: 703–22.

Moss, Timothy. 2009. "Intermediaries and the governance of sociotechnical networks in transition." *Environment and Planning A* 41 (6): 1480–95.

Murray, Alan, Keith Skene, and Kathryn Haynes. 2017. "The circular economy: An interdisciplinary exploration of the concept and application in a global context." *Journal of Business Ethics* 140 (3): 369–80.

Owen, Richard, John Bessant, and Maggy Heintz, eds. 2013. *Responsible innovation: Managing the responsible emergence of science and innovation in society*. London: Wiley.

Pauliuk, Stefan. 2018. "Critical appraisal of the circular economy standard BS 8001:2017 and a dashboard of quantitative system indicators for its implementation in organizations." *Resources, Conservation and Recycling* 129: 81–92.

Pfotenhauer, Sebastian, and Sheila Jasanoff. 2017. "Panacea or diagnosis? Imaginaries of innovation and the 'MIT model' in three political cultures." *Social Studies of Science* 47 (6): 783–810.

Piketty, Thomas, and Gabriel Zucman. 2014. "Capital is back: Wealth-income ratios in rich countries 1700–2010." *The Quarterly Journal of Economics* 129 (3): 1255–310.

Preston, Felix. 2012. *A global redesign? Shaping the circular economy*. London: Chatham House.

Ranta, Valtteri, Leena Aarikka-Stenroos, Paavo Ritala, and Saku J. Mäkinen. 2018. "Exploring institutional drivers and barriers of the circular economy: A cross-regional comparison of China, the US, and Europe." *Resources, Conservation and Recycling* 135: 70–82. https://doi.org/10.1016/j.resconrec.2017.08.017.

Rip, Arie. 2012. "The context of innovation journeys." *Creativity and Innovation Management* 21 (2): 158–70.

Rogge, Karoline S. 2016. "(Review) OECD (2015) System innovation: Synthesis report." *Environmental Innovation and Societal Transitions*. ISSN 2210-4224. https://doi.org/10.1016/j.eist.2016.05.001.

Sachs, Jeffrey D. 2015. *The age of sustainable development*. New York, NY: Columbia University Press.

Sakai, Shin-ichi, Junya Yano, Yasuhiro Hirai, Misuzu Asari, Ritsuki Yanagawa, Takeshi Matsuda, Hideto Yoshida, et al. 2017. "Waste prevention for sustainable resource and waste management." *Journal of Material Cycles and Waste Management* 19 (4): 1295–313.

Scherer, Andreas Georg, and Guido Palazzo. 2007. "Toward a political conception of corporate responsibility: Business and society seen from a Habermasian perspective." *Academy of Management Review* 32 (4): 1096–120.

Schot, Johan, and Ed Steinmueller. 2016. *Framing innovation policy for transformative change: Innovation policy 3.0*. Brighton, UK: SPRU Science Policy Research Unit, University of Sussex.

Seitanidi, Maria May, and Adam Lindgreen. 2010. "Cross-sector social interactions." *Journal of Business Ethics* 94: 1–7.

Sen, Amartya. 2001. *Development as freedom*. Oxford: Oxford University Press.

Soete, Luc. 2012. Maastricht reflections on innovation: Tans lecture 2011 (Working Paper No. 001). United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Soete, Luc. 2013. "Is innovation always good?" In *Innovation studies: Evolution & future challenges*, edited by J. Fagerberg, B. R. Martin, and E. S. Andersen, 134–44. Oxford: Oxford University Press.

Stahel, Walter R. 2016. "The circular economy." *Nature News* 531 (7595): 435.

Steffen, Will, Katherine Richardson, Johan Rockström, Sarah E. Cornell, Ingo Fetzer, Elena M. Bennett, Reinette Biggs, et al. 2015. "Planetary boundaries: Guiding human development on a changing planet." *Science* 347 (6223): 1259855.

Stiglitz, Joseph E. 2012. *The price of inequality: How today's divided society endangers our future*. New York: W. W. Norton.

Strauss, Anselm, and Juliet Corbin. 1994. "Grounded theory methodology." *Handbook of Qualitative Research* 17: 273–85.

Sturken, Marita, Douglas Thomas, and Sandra Ball-Rokeach, eds. 2004. *Technological visions: The hopes and fears that shape new technologies*. Philadelphia, PA: Temple University Press.

Taylor, Charles. 2004. *Modern social imaginaries*. Durham, NC: Duke University Press.

Unruh, Gregory C. 2000. "Understanding carbon lock-in." *Energy Policy* 28 (12): 817–30.

Van de Ven, Andrew H., Douglas Polley, and Raghu Garud. 2008. *The innovation journey*. Oxford: Oxford University Press.

van Lente, Harro, Marko Hekkert, Ruud Smits, and Bas van Waveren. 2003. "Roles of systemic intermediaries in transition processes." *International Journal of Innovation Management* 7 (3): 247–79.

22

The Impacts of Digital Technologies on Innovating for Sustainability

Sabrina Schneider

Introduction

Active engagement in digitalisation has become a priority for most organisations. Digitalisation refers to 'the social transformation triggered by the mass adoption of digital technologies that generate, process and transfer information' (Katz and Koutroumpis 2013: 314). Digital technologies have the capability to provide exact replication, infinite times at almost zero marginal cost once the required infrastructure has been established (Iansiti and Lakhani 2014). Their impacts, despite continuous uncertainty, are likely to be tremendous, and they are approaching us at an unprecedented speed (Brynjolfsson and McAfee 2015). The globally created amount of data is expected to increase from the current 25 zettabytes,[1] to more than

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150 zettabytes by 2025 (Reinsel et al. 2017). Increasing global connectivity is demonstrated by more than 4 billion active Internet users and 3.3 billion social media users as of April 2018 (Statista 2018) and by a dramatic increase in global data and communication flows (Bughin et al. 2016).

To ensure survival along the digital transformation journey, incumbent firms must rethink their ways of doing business. They are experiencing both the threats of and opportunities for adaptation and innovation provided by digital technologies (Bughin and Van Zeebroeck 2017; Keen and Williams 2013; Yoo et al. 2012). In addition to economically motivated innovation potentials, digital technologies have also displayed the potential for social and environmental contributions. For instance, Ford and Despeisse (2016) recently discussed the sustainability implications of additive manufacturing, while Gauthier and Gilomen (2016) analysed how sustainable business models can contribute to energy efficiency in cities. Bohnsack et al. (2014) looked at business models for sustainable technologies in the electric vehicle field. Despite these potential benefits, the discussion of digital technologies' impacts on sustainability remains controversial, and the question how to best leverage digital technologies to solve environmental and societal challenges remains critical (Winston 2016).

My objective here is to outline and discuss the potentials of digital technologies that firms can leverage to innovate for sustainability. The discussion follows the three key themes of strategic technology trends for 2018 identified by Gartner (2017): (1) intelligent—opportunities to leverage the potentials provided by AI and IoT, (2) digital—opportunities provided by digital manufacturing technologies such as digital twins or additive manufacturing and AR to blend digital and real worlds, and (3) mesh—opportunities in new connections of people, organisations and technologies. Following a brief introduction to the technologies, I seek to provide a balanced perspective on positive and negative influences as well as opportunities and challenges of digital technologies along the three dimensions of sustainability in hybrid organisations: economic, environmental and social impacts.

Background: Digital Technologies and Their Impacts on Business

Connectivity and recombination, rather than replacement and obsoleteness, frame the digital transformation paradigm (Iansiti and Lakhani 2014). In this environment, firms must understand how digital technologies change social interactions, so as to leverage the technologies' far-reaching potentials for business and sustainability (Greenstein et al. 2013; Hanelt et al. 2017; Yoo et al. 2012). Gartner (2017) identified three overarching current technology theme trends as the foundation for successful business activities in the digital era: intelligent, digital and mesh. It argues that, in order to achieve competitive advantage, firms must search for opportunities along this 'intelligent digital mesh'. The first technology trend theme, *intelligent*, addresses the emergence and spread of **AI** and its applications in analytics and intelligent things. AI refers to computers' increasing capacities to perform activities that previously required the involvement of human intelligence (Agrawal et al. 2017; Schoenick et al. 2017). AI can process large amounts of data within shorter times than the human brain permits (Hoffman 2016). Opportunities in this theme include the replacement, augmentation and enhancement of activities and capabilities previously performed by human resources. This theme also comprises the opportunities provided by so-called intelligent things, which link **IoT** with AI-based analytics. IoT technologies refer to information and communication environments or networks in which objects are equipped with sensors that allow them to interact with one another (Cascio and Montealegre 2016; Dijkman et al. 2015; Lee and Lee 2015) and, potentially, to act autonomously (Gartner 2017). As a result of the increasing connectivity and interaction levels provided by IoT technologies, large amounts of data have become available. The capability to perform big data analytics to effectively use this data has become an increasingly important opportunity for firms, also for those in previously low-tech industries (Davenport 2014; Loebbecke and Picot 2015).

Digital is the second theme (Gartner 2017). It refers to blending the real and the virtual worlds in order to establish a digitally enhanced environment. This includes all forms of integration of digital technologies into manufacturing processes and workflows. Digital manufacturing refers to computer-controlled production processes such as **additive manufacturing** and the use of **digital twins** in a production process. Additive manufacturing, or 3-D printing, comprises a layer-upon-layer joining of materials to a solid object based on a digital 3-D model (ASTM 2012; Huang et al. 2013; Jiang et al. 2017). Materials that can be used for additive manufacturing include a wide range of substances, ranging from steel, plastics, cement or even wooden parts (Gibson et al. 2010; Rayna and Striukova 2016). Digital twins are virtual replicas of physical objects during the manufacturing process that can help to predict key variables and allow for rapid and inexpensive digital experiments (Knapp et al. 2017; Tao et al. 2018). Further, immersive experiences created through **AR** technologies are playing an increasingly important role (Porter and Heppelmann 2017). AR is about enhancing the real world with digital features, with the aim of providing new forms of environmental perceptions. AR technologies also allow users to interact with digital technologies in new forms.

Mesh summarises the third theme (Gartner 2017). Mesh is about establishing a connection between people, organisations and technologies with the objective of generating and delivering digital outcomes. **Blockchain** technology is central to this theme. This technology refers to a peer-to-peer network that enables and records transactions based on an open, distributed ledger (Crosby et al. 2016; Iansiti and Lakhani 2017; Tapscott and Tapscott 2017). Its potential business impacts range from its original application as the foundation of the cryptocurrency Bitcoin, to the overall digitisation of transactions (Crosby et al. 2016; Tapscott and Tapscott 2017; Zhao et al. 2016). **Digital platforms** are another relevant technology type that seeks to establish connections. They represent the technological foundations that enable direct communication and interactions between different groups of actors (Edelman 2015; Zhu and Furr 2016). The platform owner usually controls the platform activities and enables interactions and transactions between the producers, who create a platform offering, and the consumers, who buy or use these products and services (van Alstyne et al. 2016). Platforms are characterised by indirect network effects, since the more users either on the producer or the consumer side, the more attractive the platform is for the other side (Casadesus-Masanell and Halaburda 2014). Further, a critical mass of actors on each side is critical for a platform to be potentially successful (Evans and Schmalensee 2010).

Digital Technologies' Potential Impacts on Sustainable Innovation

Organisations increasingly understand the importance of achieving not only economic value, but also of addressing social and environmental challenges (Rauter et al. 2017; Starik and Kanashiro 2013). Gaining a better understanding of how digital technologies can help to achieve not only economic but also social and environmental benefits is becoming increasingly relevant. Based on insights from practical examples and prior research and along the three aforementioned technology trend themes, I will discuss the potential contributions of digital technologies for sustainability and related challenges through innovation. Table 22.1 provides an overview of the discussion.

Intelligent. Theme 1 refers to digital technologies' capabilities to provide intelligent solutions and approaches based on AI and IoT technologies. From an economic perspective, these technologies help firms to generate highly accurate insights at a higher pace and to consider more data in a much more efficient way than previously possible (Moore 2016). Provided that firms are capable of analysing this information efficiently and effectively using AI's potentials, they can make more precise predictions about future developments (Pyle and San José 2015; Watson 2017). Thus, firms can identify both cost savings and additional revenue potentials. For instance, AWhere,[2] a US-based company, leverages these technologies to provide farmers with agricultural intelligence based on real-time assessments of global weather data. Another example from the commercial context is retail stores, such as the US-based retail chain Target, which uses these technologies to locate and communicate with customers the moment they approach its stores.[3] The consumer context, particularly smart home applications, presents another prominent application of these technologies (Risteska Stojkoska and

Table 22.1 Economic, social and environmental opportunities and challenges of digital technologies

Technologies		Potential benefits			Potential challenges		
		Social	*Economic*	*Environmental*	*Social*	*Economic*	*Environmental*
Intelligent - Leverage AI's potential to replace and/or augment activities and capabilities of human resources - Create intelligent things and analytics that collect and process data, react to the information and interact with systems and/or human beings	***Artificial Intelligence (AI)*** Capacity of IT to perform activities that previously required human intelligence (e.g. speech recognition, problem-solving, decision-making) (Agrawal et al. 2017; Schoenick et al. 2017) ***Internet of things (IoT)*** Information and communication environments in which objects are equipped with sensors that allow them to communicate and interact with each other (Cascio and Montealegre 2016; Dijkman et al. 2015; Lee and Lee 2015)	Precise predictions of developments and actual needs Customised solutions to actual needs Real-time response to information	Efficient and comprehensive data collection Effective data analysis, precise predictions of developments and actual needs Real-time response to information	Transparency Awareness Smart allocation of resources	Potential misuse of data and manipulation Loss of work places	Potential misuse of data and manipulation Loss of control over AI	Rebound effect (energy and consumption) Additional equipment required

(continued)

Table 22.1 (continued)

Technologies		Potential benefits			Potential challenges		
Digital - Blend real and virtual worlds to establish a digitally enhanced environment - Create new forms of perceptions and interactions among people	***Additive Manufacturing*** 3-D printing, a layer-upon-layer joining of materials to a solid object based on a digital model (ASTM 2012; Huang et al. 2013; Jiang et al. 2017) ***Digital Twins*** Virtual copy of physical objects during manufacturing process building on connected data tying the real and the virtual world (Tao et al. 2018) ***Augmented Reality (AR)*** Superimposes digital data on the physical reality (e.g. blending additional information into visual perceptions of physical reality) (Porter and Heppelmann 2017)	Local availability of products Customized solutions to actual needs Employment opportunities through upskilling	Reduction of production, storage and transportation costs Cost-efficient rapid prototyping and product customization Increase process efficiency Enhance job attractiveness	Efficient resource usage Increased product lifecycles Awareness	Loss of work places Potential misuse of data and manipulation	High costs for investments and training Technological limitations Dependence on technology Potential misuse of data and manipulation	Rebound effect (energy and consumption) Increase of scrap rate Additional equipment required

(continued)

Table 22.1 (continued)

Technologies		Potential benefits			Potential challenges		
Mesh - Establish connections between people, organizations and technology to generate and deliver digital outcomes	***Blockchain*** Peer-to-peer network that enables and records transactions based on an open, distributed ledger (Crosby et al. 2016; Iansiti and Lakhani 2017; Tapscott and Tapscott 2017) ***Digital Platforms*** Technological foundations that enable direct communication and interactions among different groups of actors (Edelman 2015; Zhu and Furr 2016)	Global reach and access Source of trust	Global reach and access Source of trust Transaction efficiencies Potential leverage of excess capacity	Enabler of crowdfunding and collaboration Reduced overall consumption to due sharing of goods and services, digital consumption and reduced commuting	Unregulated environment Digital divide preventing equal access Shortage of key resources due to economic attractiveness of sharing Threat to labour market conditions	Unregulated environment Potential misuse of data and manipulation	Rebound effect (energy and consumption)

Trivodaliev 2017; World Economic Forum 2018), where they can help to align the de facto energy consumption in private homes to individual needs and preferences. However, there are economic challenges, such as the potential misuse of data or manipulation (Lindqvist and Neumann 2017). Further, since AI often represents a black box of self-learning algorithms (Davenport 2016), loss of control over algorithms represents a potential danger connected to these technologies (Hoffman 2016).

Socially, the value of more precise predictions lies in the reduction of wasted attention spent on alerts and information that recipients receive based on inaccurate or incomplete data analytics. In contrast, receiving highly targeted and timely information in combination with customised solutions to de facto needs can be highly beneficial. One example is the use of IoT technologies by Seebo,[4] a US-based firm that offers intelligent hospital beds that monitor a patient's temperature and heart rate and alert caregivers when help is needed. However, such technologies are powerful tools to reveal very personal or confidential information that could easily be misused. Further, the increasing use of AI and IoT technologies to collect and analyse data may threaten human labour owing to increasing automation and process efficiencies (Dewhurst and Willmott 2014; Knickrehm 2018).

From an environmental perspective, AI and IoT technologies can help to increase transparency about environmental conditions. One example is Ericsson's Connected Water initiative,[5] where connected sensors collect and communicate data in order to reduce the cost and efforts required to monitor a river's water quality. Such transparency can be help to raise awareness for environmental developments. Further, transparency combined with intelligent analytics can allow for smart allocations of resources according to de facto needs, reducing overall resource consumption (Etzion and Aragon-Correa 2016). However, more precise information about de facto needs, leading to additional demand, new equipment requirements (such as sensors or processors) and additional energy required to measure, transfer and analyse data may—in turn—lead to a rebound effect, reducing the overall energy savings.

Digital. Theme 2 refers to the blending of the virtual and the real worlds through digital manufacturing and AR technologies.

Economically, these technologies can help to reduce production, storage and transportation costs. They can also enable cost-efficient rapid prototyping and product customisation opportunities (D'Aveni 2015; Rayna and Striukova 2016). The power tool manufacturer Black + Decker[6] has reported a 10% increase in throughput owing to the implementation of digital twins into its operations.[7] One common application of additive manufacturing is the production of genuine spare parts, even many years after a certain product line was produced. Mercedes-Benz for instance uses this for its truck products.[8] The economic impacts of AR, frequently associated with smart glasses that add additional data and information to an environment, builds on AR's capacity to increase transaction efficiencies by allowing users to act more rapidly and more accurately (Porter and Heppelmann 2017). The logistics provider DHL successfully piloted AR usage in its warehouse context and managed to improve the picking process by 25%.[9] Also, as the case has shown, integrating AR technologies into the workplace can increase a job's attractiveness for employees. However, employees' dependence on technological support increases, which makes a firm vulnerable in case of a technology blackout. Further, efficiency savings through digital manufacturing require high initial investment and training costs, since complex technical equipment and high expertise levels are required (Weller et al. 2015). Likewise, technological limitations concerning size and production speed must be considered, and the quality of 3-D-printed goods, particularly surface characteristics, still needs to be improved (Weller et al. 2015). Also, digital production processes could also become a target of misuse and manipulation.

Socially, additive manufacturing allows for local production of physical goods, for instance to produce required spare parts in rural areas (D'Aveni 2015). Additive manufacturing technologies also have applications in the health industry, for producing patient-friendly forms of customised medication (Wainwright 2015; Wang 2015). In 2016, US-based Aprecia Pharmaceuticals[10] offered the first FDA-approved medicine produced using additive manufacturing technology. Further, digital production technologies hold upskilling potential, i.e. workers can perform jobs they were previously underqualified for through expertise becoming embodied in products (O'Reilly 2016). Although this could help to slow down job losses as a result of automation, digital manufacturing technologies can also foster a loss of workplaces owing to increasing automation and efficiency. In addition, individuals may experience misuses of data retrieved illegally from customised digital manufacturing processes.

Environmentally, digital manufacturing processes can improve resource efficiency owing to on-demand production and reduced waste during production (Weller et al. 2015). Transportation-related emissions can be avoided by on-location production. Fast and affordable production of spare parts can further increase product lifecycles (Ford and Despeisse 2016). AR can further help to raise awareness, as displayed by After Ice,[11] an artist intervention that visualises future climate change scenarios based on NASA data. However, digital manufacturing may also create additional demand, enhancing overall consumption. Additional resources and energy are required to run digital production processes and to produce the required equipment. Further, as direct digital fabrication processes may involve less-skilled actors and potentially less-suitable materials, these processes could result in higher scrap rates than standardised mass production (Ford and Despeisse 2016).

Mesh. Theme 3 refers to the connections between people, organisations and technologies through blockchain and digital platform technologies. From an economic perspective, digital platforms expand traditional marketplaces' geographic reaches. Digital platforms are a driver of the sharing economy concept, which enables resource sharing and the leveraging of excess capacity. Blockchain technology can further serve as an independent facilitator of transactions by making even very small transactions economically viable (Iansiti and Lakhani 2017; Tapscott and Tapscott 2017). The startup Bitbond[12] leverages this opportunity by providing global access to investment and financing opportunities through a peer-to-peer bitcoin-based lending platform for small loans. The firm has managed to create a global marketplace for more than 100,000 borrowers and lenders. Further, the technology can function as a source of trust for valuable assets and transactions owing to its reliable database of historic records (Crosby et al. 2016; Iansiti and Lakhani 2017). Despite a wide range of potential application fields, including medical data, energy generation and consumption or carbon emissions (e.g. Giungato et al. 2017; Walker 2017), both the unregulated nature of the technology's business applications and potential misuse and manipulation of data on the blockchain as well as on digital platforms represent economic risks (Berke 2017; Iansiti and Lakhani 2017). Blockchain-based payment transaction systems have in the past allowed for illegal trading or money laundering (Foley et al. 2018).

Socially, blockchain technology can help to reduce global inequalities by providing equal access and enabling efficient micro-transactions. Also, using blockchain as a source of trusted origin potentially helps to prevent theft, trafficking and fraud. The startup Everledger[13] has built a blockchain technology-based digital ledger to track and protect the origins of diamonds. Everledger has reportedly uploaded more than one million diamonds' digital incarnations. Digital platforms further enable engagement and sharing among platform users who may not have met without the platform and who have excess resources. Firms such as the Berlin-based social impact startup LEIHBAR[14] have further shown that digital platforms and the sharing economy concept can also be applied in the social business context. The firm seeks to strengthen sustainable consumption by offering affordable rental services of tools, kitchen utensils or leisure equipment. At the same time, negative social implications may imply a shortage of relevant resources owing to the economic attractiveness of using them as a shared good (Martin 2016). This can potentially negatively impact on urban economies or living conditions (Ricart et al. 2017). In addition to online marketplaces for goods and services, they also affect the labour market, as shown by platforms such as Amazon Mechanical Turk.[15] This platform offers an on-demand marketplace with 24/7 availability and global reach. Such an increase in global collaboration flexibility may also lead to a shift of responsibility from organisations that employ a human workforce to individual responsibility in an increasingly on-demand work context. Global sourcing opportunities may also increase pressures on local wages and salaries. Further, equal access and consideration of all actors in the blockchain or a platform is questioned by the ongoing digital divide (Toyama 2016).

Environmentally, blockchain technology can enable positive contributions, as shown by The Sun Exchange.[16] The firm facilitates a bitcoin-based global marketplace for micro-investments in fractions of solar plants in the developing world in order to enable people across the world to use solar energy. Further, since digital platforms potentially enable more flexibility concerning where and when to work, they can help to reduce the environmental impacts of commuting (Mazmanian et al. 2013). Digital platforms can also help to promote resource sharing among multiple actors. However, peer-to-peer sharing or collaborative consumption may also create additional demands (Botsman and Rogers 2010; Martin 2016). Also, the energy consumption caused by blockchain technologies—at least according to current calculation—is very high (Giungato et al. 2017). According to estimations by Digiconomist,[17] the carbon footprint of one transaction of the cryptocurrency bitcoin is estimated to be more than 116 kg of CO_2 (as at 15 December 2017).

Conclusion

Digital technologies have transformative impacts on business and society. However, the paths these transformations will take are still uncertain. This chapter's main contribution was to establish the links between specific digital technologies and their economic, social and environmental impacts. The discussion revealed a multitude of both positive and negative potential implications. Economic opportunities centre on efficiency gains and business prospects that build on new connections, while potential economic challenges include the misuse and manipulation of data, dependence on technologies, and high investment costs. The social opportunities include customised needs satisfaction and equal individual enablement, while potential social challenges include job market threats, data misuse and continuing inequalities. Environmentally, the opportunities focus on increasing transparency and awareness and reducing consumption, while the potential challenges centre on rebound effects owing to additional consumption and production caused by the availability of digital technologies.

Future research should address strategies of how firms can maximise the positive implications while minimising the negative ones, along all three dimensions. Further, researchers should emphasise how these technologies can be used in combination, potentially reinforcing one another in positive ways. For managerial practice, this comprehensive overview displays the manifold innovation opportunities enabled by digital technologies for firms' current and future business. The simultaneous transparency of economic, social and environmental implications seeks to motivate incumbents and startups to reflect on the full range of consequences when shaping their digital strategies.

Notes

1. 1 zettabyte = 909.49470177293 million terabytes.
2. Website: https://www.awhere.com/.
3. https://corporate.target.com/article/2015/08/beacon-technology.
4. Website: https://www.seebo.com/.
5. https://www.ericsson.com/thecompany/sustainability_corporateresponsibility/technology-for-good-blog/2016/09/06/connected-water-how-sensors-and-iot-protect-a-precious-resource/.
6. Website: https://www.blackanddecker.com/.
7. https://www.weforum.org/agenda/2015/10/can-the-digital-twin-transform-manufacturing/.
8. https://www.daimler.com/sustainability/production/3d-print.html.
9. www.dhl.com/en/press/releases/releases_2015/logistics/dhl_successfully_tests_augmented_reality_application_in_warehouse.html.
10. www.multivu.com/players/English/7764551-aprecia-pharmaceuticals-spritam/.
11. Website: https://guariglia.com/.
12. Website: https://www.bitbond.com/.
13. Website: https://www.everledger.io/.
14. Website: https://leihbar.net/ueber-leihbar/.
15. Website: https://www.mturk.com/.
16. Website: https://thesunexchange.com/.
17. Website: https://digiconomist.net/bitcoin-energy-consumption.

References

Agrawal, A., J. S. Gans, and A. Goldfarb. 2017. "What to expect from artificial intelligence." *MIT Sloan Management Review* 58 (3): 23–26.

ASTM. 2012. *ASTM F2792-12a: Standard terminology for additive manufacturing technologies*. West Conshohocken, PA: ASTM International.

Berke, A. 2017. "How safe are blockchains? It depends." *Harvard Business Review Digital Articles*, March 7.

Bohnsack, R., J. Pinske, and A. Kolk. 2014. "Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles." *Research Policy* 43 (2): 284–300.

Botsman, R., and R. Rogers. 2010. *What's mine is yours: How collaborative consumption is changing the way we live*. London, UK: Collins.

Brynjolfsson, E., and A. McAfee. 2015. "The great decoupling." *Harvard Business Review* 93 (6): 66–74.

Bughin, J., and N. van Zeebroeck. 2017. "The best response to digital disruption." *MIT Sloan Management Review* 58 (4): 80–86.

Bughin, J., S. Lund, and J. Manyika. 2016. "Five priorities for competing in an era of digital globalization." *McKinsey Quarterly* 2: 55–61.

Casadesus-Masanell, R., and H. Halaburda. 2014. "When does a platform create value by limiting choice?" *Journal of Economics & Management Strategy* 23 (2): 259–93.

Cascio, W. F., and R. Montealegre. 2016. "How technology is changing work and organizations." *Annual Review of Organisational Psychology and Organizational Behavior* 3: 349–75.

Crosby, M., Nachiappan, P. Pattanayak, S. Verma, and V. Kalyanaraman. 2016. "BlockChain technology: Beyond bitcoin." *Applied Innovation Review* 2: 6–19.

D'Aveni, R. 2015. "The 3-D printing revolution." *Harvard Business Review* 93 (5): 40–48.

Davenport, T. H. 2014. *Big data @ work*. Cambridge, MA: Harvard University Press.

Davenport, T. H. 2016. "7 ways to introduce AI into your organization." *Harvard Business Review Digital Articles*.

Dewhurst, M., and P. Willmott. 2014. "Manager and machine: The new leadership equation." *McKinsey Quarterly* 4 (3): 76–86.

Dijkman, R. M., B. Sprenkels, T. Peeters, and A. Janssen. 2015. "Business models for the Internet of things." *International Journal of Information Management* 35 (6), December: 672–78.

Edelman, B. 2015. "How to launch your digital platform." *Harvard Business Review* 93 (4): 90–97.

Etzion, D., and J. A. Aragon-Correa. 2016. "Big data, management, and sustainability: Strategic opportunities ahead." *Organization & Environment* 29 (2): 147–55.

Evans, D. S., and R. Schmalensee. 2010. "'Failure to launch': Critical mass in platform business." *Review of Network Economics* 9 (4): 1–26.

Foley, S., J. R. Karlsen, and T. J. Putniņš. 2018. "Sex, drugs, and bitcoin: How much illegal activity is financed through cryptocurrencies?" *SSRN*, January 15. https://ssrn.com/abstract=3102645 or http://dx.doi.org/10.2139/ssrn.3102645.

Ford, Simon, and Mélanie Despeisse. 2016. "Additive manufacturing and sustainability: An exploratory study of the advantages and challenges." *Journal of Cleaner Production* 137, November 20: 1573–87.

Gartner. 2017. "Top 10 strategic technology trends for 2018." https://www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technology-trends-for-2018/.

Gauthier, C., and B. Gilomen. 2016. "Business models for sustainability: Energy efficiency in urban districts." *Organization & Environment* 29 (1): 124–44.

Gibson, I., D. W. Rosen, and B. Stucker. 2010. *Additive manufacturing technologies: Rapid prototyping to direct digital manufacturing*. New York, NY: Springer.

Giungato, P., R. Rana, A. Tarabella, and C. Tricase. 2017. "Current trends in sustainability of bitcoins and related blockchain technology." *Sustainability* 9 (12): 2214. https://doi.org/10.3390/su9122214.

Greenstein, S., J. Lerner, and S. Stern. 2013. "Digitization, innovation, and copyright: What is the agenda?" *Strategic Organization* 11 (1): 110–21.

Hanelt, Andre, Sebastian Busse, and Lutz M. Kolbe. 2017. "Driving business transformation toward sustainability: Exploring the impact of supporting IS on the performance contribution of eco-innovations." *Information Systems Journal* 27 (4), July: 463–502.

Hoffman, R. 2016. "Using artificial intelligence to set information free." *MIT Sloan Management Review* 58 (1): 14–17.

Huang, S. H., P. Liu, A. Mokasdar, and L. Hou. 2013. "Additive manufacturing and its societal impact: A literature review." *International Journal of Advanced Manufacturing Technology* 67: 1191–203.

Iansiti, M., and K. R. Lakhani. 2014. "Digital ubiquity: How connections, sensors, and data are revolutionizing business." *Harvard Business Review* 92 (11): 90–99.

Iansiti, M., and K. R. Lakhani. 2017. "The truth about blockchain." *Harvard Business Review* 95 (1): 118–27.

Jiang, R., R. Kleer, and F. T. Piller. 2017. "Predicting the future of additive manufacturing: A delphi study on economic and societal implications of 3D printing for 2030." *Technological Forecasting and Social Change*. https://doi.org/10.106/j.techfore.2017.01.006.

Katz, R. I., and P. Koutroumpis. 2013. "Measuring digitization: A growth and welfare multiplier." *Technovation* 33: 314–19.

Keen, P., and R. Williams. 2013. "Value architecture for digital business: Beyond the business model." *MIS Quarterly* 37 (2): 643–47.

Knapp, G. L., T. Mukherjee, J. S. Zuback, H. L. Wei, T. A. Palmer, A. De, and T. DeRoy. 2017. "Building blocks for a digital twin of additive manufacturing." *Acta Materialia* 135: 390–99.

Knickrehm, M. 2018. "How will AI change work? Here are 5 schools of thought." *Harvard Business Review Digital Articles*.

Lee, I., and K. Lee. 2015. "The Internet of things (IoT): Applications, investments, and challenges for enterprises." *Business Horizons* 58: 431–40.

Lindqvist, Ulf, and Peter G. Neumann. 2017. "The future of the Internet of things." *Communications of the ACM* 60 (2), February: 26–30.

Loebbecke, C., and A. Picot. 2015. "Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda." *Journal of Strategic Information Systems* 24: 149–57.

Martin, C. J. 2016. "The sharing economy: A pathway to sustainability or a nightmarish form of neoliberal capitalism?" *Ecological Economics* 121: 149–59.

Mazmanian, M., W. J. Orlikowski, and J. Yates. 2013. "The autonomy paradox: The implications of mobile email devices for knowledge professionals." *Organization Science* 24: 1337–57.

Moore, A. W. 2016. "Predicting a future where the future is routinely predicted." *MIT Sloan Management Review* 58 (1): 12–13.

O'Reilly, T. 2016. "Managing the bots that are managing the business." *MIT Sloan Management Review* 58 (1): 3–4.

Porter, M. E., and J. E. Heppelmann. 2017. "Why every organization needs an augmented reality strategy." *Harvard Business Review* 95 (6), December 11: 46–57.

Pyle, D., and C. San José. 2015. "An executive's guide to machine learning." *McKinsey Quarterly* (3): 44–53.

Rauter, R., J. Jonker, and R. J. Baumgartner. 2017. "Going one's own way: Drivers in developing business models for sustainability." *Journal of Cleaner Production* 140: 144–54.

Rayna, T., and L. Striukova. 2016. "From rapid prototyping to home fabrication: How 3D printing is changing business model innovation." *Technological Forecasting and Social Change* 102: 214–24.

Reinsel, D., J. Gantz, and J. Rydning. 2017. "Data age 2025: The evolution of data to life-critical." IDC white paper. https://www.seagate.com/files/www-content/our-story/trends/files/Seagate-WP-DataAge2025-March-2017.pdf.

Ricart, J. E., P. Berrone, and A. I. Duch. 2017. "How the collaborative economy is changing cities." IESE Cities in Motion blogNetwork, March 15. http://blog.iese.edu/cities-challenges-and-management/2017/03/15/how-the-collaborative-economy-is-changing-cities/.

Risteska Stojkoska, B. L., and K. V. Trivodaliev. 2017. "A review of Internet of things for smart home: Challenges and solutions." *Journal of Cleaner Production* 140, Part 3, January 1: 1454–64.

Schoenick, C., P. Clark, O. Tafjord, P. Turney, and O. Etzioni. 2017. "Moving beyond the turing test with the Allen AI Science challenge." *Communications of the ACM* 60 (9), September: 60–64.

Starik, M., and P. Kanashiro. 2013. "Toward a theory of sustainability management: Uncovering and integrating the nearly obvious." *Organization & Environment* 26: 7–30.

Statista. 2018. "Global digital population as of April 2018 (in millions)." https://www.statista.com/statistics/617136/digital-population-worldwide/.

Tao, F., J. Cheng, Q. Qi, M. Zhang, M. Zhang, H. Zhang, and F. Sui. 2018. "Digital twin-driven product design, manufacturing and service with big data." *International Journal of Advanced Manufacturing Technology* 94 (9–12): 3563–76.

Tapscott, D., and A. Tapscott. 2017. "How blockchain will change organizations." *MIT Sloan Management Review* 58 (2): 10–13.

Toyama, K. 2016. "The Internet and inequality." *Communications of the ACM* 59 (4), April: 28–30.

van Alstyne, M. W., G. G. Parker, and S. P. Choudary. 2016. "Pipelines, platforms, and the new rules of strategy: Scale now trumps differentiation." *Harvard Business Review* 94 (4): 54–62.

Wainwright, O. 2015. "The first 3D-printed pill opens up a world of downloadable medicine." *The Guardian*. https://www.theguardian.com/artanddesign/architecture-design-blog/2015/aug/05/the-first-3d-printed-pill-opens-up-a-world-of-downloadable-medicine.

Walker, L. 2017. "This new carbon currency could make us more climate friendly." World Economic Forum, September 19. https://www.weforum.org/agenda/2017/09/carbon-currency-blockchain-poseidon-ecosphere/.

Wang, A. Z. 2015. "Personalized drug tablets with 3D printing." *Science Translational Medicine* 7 (312): 312–19.

Watson, H. J. 2017. "Preparing for the cognitive generation of decision support." *MIS Quarterly Executive* 16 (3): 153–69.

Weller, C., R. Kleer, and F. T. Piller. 2015. "Economic implications of 3D printing: Market structure models in light of additive manufacturing revisited." *International Journal of Production Economics* 164: 43–56.

Winston, A. S. 2016. "Tackling the world's challenges with technology." *MIT Sloan Management Review* 58 (1): 19–20.

World Economic Forum. 2018. "Internet of things—Guidelines for sustainability." http://www3.weforum.org/docs/IoTGuidelinesforSustainability.pdf.

Yoo, Y., R. J. Boland, K. Lyytinen, and A. Majchzak. 2012. "Organizing for innovation in the digitized world." *Organization Science* 23 (5): 1398–1408.

Zhao, J. L., S. Fan, and J. Yan. 2016. *Financial Innovation* 2: 28. https://doi.org/10.1186/s40854-016-0049-2.

Zhu, F., and N. Furr. 2016. "Products to platforms: Making the leap." *Harvard Business Review* 94 (4): 72–78.

23

Online Platforms and the Circular Economy

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Introduction

Online platforms have become essential for many people. They organise data streams, economic interactions and social exchanges between users

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(van Dijck et al. 2018). The platform-based companies Google, Apple, Facebook and Amazon have aggregated power at unprecedented speed and scale: their combined market capitalisation grew from $430 billion in 2010 (roughly the GDP of Poland) to more than $2300 billion in 2017 (roughly the GDP of India, the seventh largest economy in the world[1]) (Galloway 2017). These four 'GAFA platforms' sit at the core of what is becoming a platform society, in which a global, corporate infrastructure uses data and algorithms to organise social and economic interactions (van Dijck et al. 2018). From a business perspective, online platforms are seen as multi-sided marketplaces that can enable people to efficiently exchange a large variety of physical products (e.g. used cars or furniture), build communities around specific product categories (e.g. handmade design), match service firms with users (e.g. local food delivery), exchange online services (e.g. language tutoring) and engage in peer-to-peer exchange of offline services (e.g. ridesharing) (Täuscher and Laudien 2017).

The main question for firms who launch and manage online platforms is how they enable others to create value on their platforms (Bonchek and Choudary 2013). Interactions and data have become key assets for this. The ability to collect and leverage data from interactions is driving competitive advantage in the platform society (Van Alstyne et al. 2016). The more sides, the more interactions; the more interactions, the more opportunities to collect and analyse data to increase platform value. This is called 'network effects', whereby every additional user on the platform increases the value of the overall platform (Gawer and Cusumano 2014). Some have claimed that understanding this new form of competitive advantage has become key for firm survival (Van Alstyne et al. 2016).

Recently, online platforms have been named an enabler for a circular economy (e.g. Lewandowski 2016). The goal of a circular economy is to radically increase resource efficiency on a systems level by maximising the value of products, components and material, while minimising resource inputs, waste, emission and energy leakage (EMF 2015; Geissdoerfer et al. 2017). This can be done by narrowing (use less), slowing (use longer) and closing (use again) resource loops. Narrowing refers to maximising efficiency and reducing material intensity of products, components and material; slowing seeks to maximise the value of products and components within the economic system by reusing, repairing, maintaining, refurbishing, remanufacturing and sharing them; closing means the recycling of material at the end of product and component lives. The circular economy can be described as a sub-concept of sustainable innovation. It can potentially speed up the adoption of more resource-efficient ways of doing business, as it is more narrowly defined than the broader field of sustainable innovation (Geissdoerfer et al. 2017). Some have claimed that online platforms have contributed to implementing a circular economy by allowing people and organisations to share access to underused physical goods and thereby reduce their excess capacity and slow resource loops (EMF 2015). Google, one of the biggest online platforms, has partnered with the Ellen MacArthur Foundation to digitally enable a circular economy (EMF 2017).

So far, literature has mostly addressed the environmental sustainability of online platforms in the so-called sharing economy. Their potential impact on the environment appears to be mixed: sharing economy platforms can both contribute to sustainability (e.g. by reducing excess capacity) and inhibit it (e.g. by increased energy use of growing data centres) (Lelah et al. 2011; Frenken and Schor 2017). We extend this perspective and investigate how online platforms can enable a more sustainable and circular economy. A review of relevant literature reveals three roles online platforms can play in this: they can serve to (1) market, (2) operate and (3) co-create products, components and material. In the next section, we describe these roles and use practice examples to highlight their potential in enabling a more circular economy. We then provide a recommendations for how practitioners can experiment with online platforms to advance their digital transition towards a circular economy.

Online Platforms and the Circular Economy

Online platforms can serve as a means to market, operate, and co-create products, components and material in order to narrow, slow and close resource loops in a circular economy. Table 23.1 shows how we have

Table 23.1 The roles of online platforms, how literature describes them and their key potential for a circular economy

Role	Literature description	Key potential for a circular economy
Market	Coordinate economic interactions between groups of platform actors (Chasin et al. 2017)	Share access to existing products
	Handle messages, execute transactions, provide market overviews and price transparency, support customer decisions, share information, support product innovation (Alt and Klein 2011)	Resell and trade used products and waste material
	Crowdfunding platforms (a specific type of electronic marketplace): a promising source of sustainable venture capital (Bocken 2015)	
	Reduce transaction cost, minimise excess capacity (sharing economy) (Frenken and Schor 2017)	
	Interactions and data as key assets for creating value and driving competitive advantage (Van Alstyne et al. 2016)	
	Network effects as a strategic goal (Gawer and Cusumano 2014)	
Operate	Enablers of collaborative product-service systems and servitisation (Evans et al. 2007; Manzini and Vezzoli 2003; Baines and Lightfoot 2013; Cenamor et al. 2015)	Collaborate with others to jointly provide product-service systems
	Drive customisation and efficiency for servitised offerings (Cenamor et al. 2015)	Collect data to maintain and repair
	The gateways to providing, accessing and maintaining physical assets to inform maintenance and repair (Morlet et al. 2016)	

(continued)

Table 23.1 (continued)

Role	Literature description	Key potential for a circular economy
Co-create	Enablers of citizen and community participation, empowerment, collective action, inclusive co-creation of internet-of-things applications and open innovation, with an emphasis on smart cities (Lee et al. 2014; Stratigea et al. 2015; Hribernik et al. 2011; Anttiroiko et al. 2014)	Repair, (re-)design, own, manufacture Share knowledge and information
	A means for information exchange, knowledge creation, feedback, debate, learning, innovation and social networking (Medema et al. 2014), encourage partnerships and co-creation of sets of platform elements (Evans et al. 2007)	Debate and learn

allocated the relevant literature[2] within these three roles, and what their key potential is in enabling a more circular economy. In the following sections, we describe this in more detail and provide examples for how these three roles have been put into practice.

Market

Online platforms serve as electronic markets (Alt and Klein 2011). They coordinate exchange between groups of platform actors (Chasin et al. 2017), by handling their communication, providing market overviews and price transparency, supporting customer decisions and sharing relevant information (Alt and Klein 2011). Moreover, crowdfunding platforms have been described as promising sources of sustainable venture capital (Bocken 2015).

As electronic markets in a circular economy, online platforms can potentially help slow resource loops by enabling access to existing products. This is often referred to as the sharing economy. Examples include Peerby (enables temporary access to private goods like drills or bicycles) or Airbnb (enables temporary access to private homes). Reduced transaction cost has enabled people and organisations to share access to their products and thereby reduce and monetise their excess capacity (Frenken and Schor 2017). For example, three empty seats in a car while driving on the road equal to an excess capacity of 75%. If a person makes these seats available, then he or she is decreasing and/or monetising excess capacity, enabled by reduced transaction cost. This form of 'sharing' as an economic transaction has become a recognised business action for implementing a circular economy (EMF 2015). The idea is that excess capacity might help to slow resource flows because using existing products instead of buying new ones can reduce the need for new products and associated resources.

Even though many sharing economy platforms have claimed environmental benefits, they also seem to inhibit sustainability (Frenken and Schor 2017). For example, they have expanded trade volumes and created additional purchasing power beyond reducing the excess capacity of existing products (ibid.). This has led to indirect rebounds that can offset potential benefits (Chitnis et al. 2013). Next to indirect rebounds, power-consuming data centres and the environmental impacts of used hardware may lead to further direct rebounds (Boons and Bocken 2017). Especially, sharing economy platforms tend to use and sustain existing, potentially unsustainable infrastructure. The car-sharing platform Zipcar, for example, runs mostly on fossil-fuel-based vehicles. Airbnb provides access to houses that can consume high levels of energy. Due to their dependence on mobile and wireless infrastructure, online platforms have also contributed to the overall environmental impacts of mobile communication (ibid.).

In general, whether online platforms as markets contribute to environmental sustainability is a matter of deliberate design choices (Tukker 2015; Mont 2002; Bocken 2017). This can be seen in examples that leverage online platforms as markets for used products and waste material. The online platform Fairmondo, for example, promotes used, more sustainable and long-lasting products and charges a lower commission for providers of fair and sustainable products. The platform Kleiderkreisel enables its users to resell used clothing. The Materials Marketplace facilitates the reuse of company-to-company industrial waste. These platforms thus make deliberate choices to enable the slowing and closing of resource loops via online platforms.

Operate

Online platforms can serve to operate product-service systems (Alt and Klein 2011; Manzini and Vezzoli 2003; Cenamor et al. 2015). Product-service systems refer to a combination of products and services to create customer value (Boehm and Thomas 2013). Products can be provided on three service levels: basic (e.g. product sale plus warranty), intermediate (product sale plus maintenance, repair or training services) and advanced (no product sale, instead a focus on outcomes and solutions) (Baines and Lightfoot 2013). Intermediate services often aim at extending the lifetimes of products (e.g. through maintenance contracts). Advanced services, in which firms retain ownership over their products, incentivise firms to invest in long-lasting products that are easy to maintain and repair. They can therefore enable a more circular economy (Tukker 2015).

Online platforms can be used to operate product-service systems by collecting data on the use, location and condition of deployed products. This can help to slow resource loops by optimising their use and flagging the need for maintaining, repairing, refurbishing and remanufacturing them (Morlet et al. 2016). A recent article has described how platforms can help optimise service offerings (Cenamor et al. 2015). The back end (the non-user facing side) of a platform can orchestrate diverse offerings, while the front end (the user-facing side) can customise them for individual use cases (ibid.). Online platforms can thus be seen as the gateways to providing, accessing and maintaining physical assets in flexible ways (Morlet et al. 2016). In theory, everything can be connected to collect, analyse and use data to optimise the use of products, components and material.

This can potentially involve many different actors across sectors who become part of complex service ecosystems. An example of a multi-sided online platform is the company Instacart, which delivers groceries from local stores to people's doorsteps (Stanley 2017). It coordinates interactions between four sides: customers who receive the delivered groceries, shoppers who get contracted to shop and deliver them, stores who provide the inventory of products and products that get searched, picked and delivered. The company's director of data science explains: '*it turns out that the four-sided marketplace is a lot more complex than just a two-sided marketplace [and] every pair of interactions is a significant opportunity and a significant source of data, a significant potential place to influence and affect things*' (Stanley 2017, paragraph 28).

This ability to influence and affect things can be leveraged to collect and analyse data to optimise the use and exchange of products, components and material in a system to narrow, slow and close resource loops. The German project Adaptive City Mobility, for example, seeks to provide a zero-emissions e-mobility system for cities via a common online platform. It is designed to coordinate interaction between at least five entities: local fleet operators (e.g. taxi companies) who operate flexible pools of lightweight, electric vehicles, end users who can access the same vehicles, service providers who maintain and repair the vehicles, local energy providers who can sell their renewable energy through the battery management and exchange system of the vehicles, and local service providers (e.g. restaurants) who can promote their offerings through ads that are shown on the vehicle displays. The software orchestrates this complex service ecosystem through careful, collaborative design.

Co-create

Lastly, online platforms can empower people to co-create products and services (Evans et al. 2007). This includes the co-creation and exchange of information and knowledge, and the opportunity to debate and learn (Medema et al. 2014). Literature has emphasised this mostly in the context of smart cities (Lee et al. 2014; Stratigea et al. 2015; Hribernik et al. 2011; Anttiroiko et al. 2014).

Most online platforms that enable the co-creation of products and services for a circular economy are part of the so-called open source movement (Bakker et al. 2018). The movement proposes that individuals want or need to participate in creating a circular economy. Repair cafes, maker spaces, sharing economy platforms and distributed manufacturing are current manifestations of this interpretation (ibid.). Popular examples of online platforms that enable people to co-create the circular economy include iFixit, which provides crowd-sourced repair kits for products, as well as the Open Source Circular Economy Days, a platform that allows people to explore and co-create a circular economy through open source methods and solutions.

Further examples of how people and firms can co-create on online platforms include: Mobotiq, a blockchain-based, clean mobility startup that has built an online platform on which individuals can become investors, designers, manufacturers and operators. The mobility company Local Motors has set out to let thousands of people co-create vehicle designs that are adaptable, open, customisable and repairable. The cooperative car-sharing platform Modo has fostered co-creation through shared ownership, and therefore shared care, of physical assets. Finally, the ride-sharing platform LaZooz, also focused on using physical resources (in this case, cars) more effectively, has offered a decentralised peer-to-peer ride-sharing service with its own token system for unlimited ways of co-creating value on the platform.

Despite these examples, the overall level of co-creation via online platforms has been decreasing over the past years (it should, however, be noted that not all online platforms have been initiated with a 'co-creative intent'). Nevertheless, van Dijck et al. have argued that, rather than enabling new forms of co-creation, sharing economy platforms have become a mere facilitator of economic transaction (2018). In addition, a recent review of online platforms has found no evidence that online platforms contribute to a decentralisation or democratisation of innovation processes (Dolata 2017). To the contrary, concentrated corporate power clusters have dominated the platform society in terms of traffic and market value. The online platforms that form the core of these clusters have exceptional stock market values and considerable liquidity, which they use to undertake high investments and major acquisitions on a regular basis (ibid.). This indicates an overall decline of the use of the co-creation potential of online platforms.

Also here it is important to realise that using this potential role is a design choice. The above examples show the many possibilities: people and organisations can collaborate to share knowledge and information, repair, (re)design, own and manufacture products, components and material through online platforms. Leach et al. have stressed the importance of this in light of sustainable development goals: '*[…] delivering on [sustainable development goals] requires a radically new approach to innovation, one that gives far greater recognition and power to grassroots actors and processes, involving them within an inclusive, multi-scale innovation politics*' (2012: 1). Fostering co-creation on online platforms can thus be seen as an important mandate for sustainable development. The above examples show initial ways of how this can be done.

Recommendations for Practitioners

The highlighted roles of online platforms can serve as a playground for firms to come up with new ideas for transitioning towards a circular economy. Figure 23.1 provides an overview of the three roles.

Some example questions to support ideation of how online platforms can be used to market, operate and co-create products, components and material include:

Fig. 23.1 The roles of online platforms in enabling a circular economy: market, operate and co-create products, components and material

- Market:
  - How can a firm use existing online platforms to reduce the excess capacity of their products? How radical would this be compared to the current way of doing business? How can this become a viable possibility, e.g. by collaborating with online platforms?
  - Does a firm have waste materials that can potentially be traded via online platforms? Can waste materials that are traded on online platforms be used as product inputs?
- Operate:
  - How can firms connect to existing online platforms to offer and evolve their products and services as part of larger product-service systems? What kinds of collaborations would be needed for that?
  - How can firms collaborate with others to co-create new online platforms that support the circular economy?

- Co-create:
  - How can firms use online platforms as a tool to co-create circular products, components and materials, as well as services, with outside parties?
  - How can firms leverage online platforms to obtain and share information and knowledge about their products in support of the circular economy?

New ideas are usually full of assumptions about how and whether they are desirable, feasible and viable (Osterwalder et al. 2014). A next step would then be to formulate, prioritise and test these assumptions. For example, finding a way of reselling already-sold and used products via online platforms assumes that this aligns with the existing firm philosophy, that a particular set of customers desire them, that it is feasible to do this in terms of available and accessible skills and resources, or that it is viable in terms of costs and benefits. Conducting business experiments to test these kinds of assumptions can help make first steps to start leveraging the roles of online platforms for narrowing, slowing and closing resource loops (Bocken et al. 2018). This requires an open mindset: only by allowing new ideas to emerge, and by testing their assumptions will firms 'fail forward' (Ries 2017) and learn how they can transition towards a digital, circular economy.

Conclusion

This chapter has highlighted three roles online platforms can play in enabling a circular economy. First, as markets, they can reduce excess capacity and enable the reselling of used products, components and material. Second, in their role as operators of product-service systems, they can coordinate complex service ecosystems and inform maintenance and repair needs. Third, their role in fostering co-creation opens new ways for collaborating and participating in different kinds of activities. Examples have shown how these roles have been leveraged in practice. With this work, we hope to inform practitioners about the importance and potential of online platforms and to inspire them to think about this potential in their own contexts. From a theoretical perspective, we contribute a framework for the roles of online platforms in enabling a circular economy. The three roles are by no means exhaustive. Ample research is still needed to better understand how online platforms can be used to enable a circular economy. This also applies to sustainable innovation more generally, as this chapter has focused on the more narrow aspects of product, component and material flows. It is therefore crucial to pay equal attention in the future to their role in addressing social issues like income equality and social cohesion.

Notes

1. We acknowledge that this is a bit like comparing apples and oranges. But it indicates how rapidly and at what scale platforms have been growing.
2. We used literature from a targeted search in the most cited articles on sustainable innovation. Even though the focus of this chapter is on the circular economy, we used literature on sustainable innovation because the former has emerged from the latter and can therefore be further informed by it. We used a variety of search strings (e.g.: "sustainable innovation" AND platform* (results: 35); or: platform* AND sustainability AND innovation (results: 294); or: 'sustainability AND digital* AND platform*' (results: 181) or 'sharing economy AND sustainability' (results: 58) for titles, keywords and abstracts in the academic database SCOPUS. We filtered articles that: (1) clearly refer to online platforms as defined in this article, (2) are no older than ten years and (3) that have been cited more than 10 times or have been published within the last two years. We ended up with 15 articles for review.

References

Alt, Rainer, and Stefan Klein. 2011. "Twenty years of electronic markets research—Looking backwards towards the future." *Electronic Markets* 21 (1): 41–51.

Anttiroiko, Ari Veikko, Pekka Valkama, and Stephen J. Bailey. 2014. "Smart cities in the new service economy: Building platforms for smart services." *AI and Society* 29 (3): 323–34.

Baines, Timothy, and Howard Lightfoot. 2013. *Made to serve. How manufactureres can compete through servitization and product-service systems*. NJ: Wiley.

Bakker, Conny, Ruud Balkenende, and Flora Poppelaars. 2018. "Design for product integrity in a circular economy." In *Designing for the circular economy*, edited by Martin Charter. London: Routledge (Taylor & Francis Group).

Bocken, N. M. P. 2015. "Sustainable venture capital—Catalyst for sustainable start-up success?" *Journal of Cleaner Production* 108: 647–58.

Bocken, Nancy. 2017. "Business-led sustainable consumption initiatives: Impacts and lessons learned." *Journal of Management Development* 36 (1): 81–96.

Bocken, Nancy, C. S. C. Schuit, and Christiaan Kraaijenhagen. 2018. "Experimenting with a circular business model: Lessons from eight cases." *Environmental Innovation and Societal Transitions*. https://doi.org/10.1016/j.eist.2018.02.001.

Boehm, Matthias, and Oliver Thomas. 2013. "Looking beyond the rim of one's teacup: A multidisciplinary literature review of product-service systems in information systems, business management, and engineering & design." *Journal of Cleaner Production* 51: 245–60.

Bonchek, Mark, and Sangeet Paul Choudary. 2013. "Three elements of a successful platform strategy." *Harvard Business Review* 92 (1–2).

Boons, Frank, and Nancy Bocken. 2017. "Assessing the sharing economy: Analyzing ecologies of business models." In *Product lifetimes and the environment 2017—Conference proceedings*, 46–50.

Cenamor, J., D. Rönnberg Sjödin, and V. Parida. 2015. "Adopting a platform approach in servitization: Leveraging the value of digitalization." *International Journal of Production Economics* 192: 54–65.

Chasin, Friedrich, Moritz von Hoffen, Marcus Cramer, and Martin Matzner. 2017. "Peer-to-peer sharing and collaborative consumption platforms: A taxonomy and a reproducible analysis." *Information Systems and E-Business Management* 16 (2): 293–325.

Chitnis, Mona, Steve Sorrell, Angela Druckman, Steven K. Firth, and Tim Jackson. 2013. "Turning lights into flights: Estimating direct and indirect rebound effects for UK households." *Energy Policy* 55: 234–50.

Dolata, Ulrich. 2017. "Apple, Amazon, Google, Facebook, Microsoft. Market concentration—Competition—Innovation strategies." *Research Contributions to Organizational Sociology and Innovation Studies Discussion Paper 2017–01*.

EMF. 2015. "Growth within: A circular economy vision for a competitive Europe." Ellen MacArthur Foundation.

EMF. 2017. "Google—Partner of the Ellen MacArthur Foundation." Accessed May 2018. https://www.ellenmacarthurfoundation.org/about/partners/global/google.

Evans, Stephen, Paulo J. Partidário, and Joanna Lambert. 2007. "Industrialization as a key element of sustainable product-service solutions." *International Journal of Production Research* 45 (18–19): 4225–46.

Frenken, Koen, and Juliet Schor. 2017. "Putting the sharing economy into perspective." *Environmental Innovation and Societal Transitions* 23: 3–10.

Galloway, Scott. 2017. The four: The hidden DNA of Amazon, Apple, Facebook, and Google. New York: Penguin Random House.

Gawer, Annabelle, and Michael A. Cusumano. 2014. "Industry platforms and ecosystem innovation." *Journal of Product Innovation Management* 31 (3): 417–33.

Geissdoerfer, Martin, Paulo Savaget, Nancy M. P. Bocken, and Erik Jan Hultink. 2017. "The circular economy—A new sustainability paradigm?" *Journal of Cleaner Production* 143: 757–68.

Hribernik, Karl A., Zied Ghrairi, Carl Hans, and Klaus-dieter Thoben. 2011. "Co-creating the internet of things—First experiences in the participatory design of intelligent products with Arduino." In *17th International Conference On Concurrent Enterprising (ICE)*, no. Ice, 1–9.

Leach, Melissa, Johan Rockström, Paul Raskin, Ian Scoones, Andy C. Stirling, Adrian Smith, John Thompson, et al. 2012. "Transforming innovation for sustainability." *Ecology and Society* 17 (2): 11.

Lee, Jung Hoon, Marguerite Gong Hancock, and Mei Chih Hu. 2014. "Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco." *Technological Forecasting and Social Change* 89: 80–99.

Lelah, Alan, Fabrice Mathieux, and Daniel Brissaud. 2011. "Contributions to eco-design of machine-to-machine product service systems: The example of waste glass collection." *Journal of Cleaner Production* 19 (9–10): 1033–44.

Lewandowski, Mateusz. 2016. Designing the business models for circular economy—Towards the conceptual framework. *Sustainability* 8 (1): 1–28.

Manzini, E., and C. Vezzoli. 2003. "A strategic design approach to develop sustainable product service systems: Examples taken from the 'environmentally friendly innovation' Italian prize." *Journal of Cleaner Production* 11 (8): 851–57.

Medema, Wietske, Arjen Wals, and Jan Adamowski. 2014. "Multi-loop social learning for sustainable land and water governance: Towards a research agenda on the potential of virtual learning platforms." *NJAS—Wageningen Journal of Life Sciences* 69: 23–38.

Mont, Oksana. 2002. "Clarifying the concept of product—Service system." *Journal of Cleaner Production* 10: 237–45.

Morlet, Andrew, Jocelyn Blériot, Rob Opsomer, Mats Linder, Anina Henggeler, Alix Bluhm, and Andrea Carrera. 2016. "Intelligent assets: Unlocking the circular economy potential." Ellen MacArthur Foundation, 1–25.

Osterwalder, Alexander, Yves Pigneur, Greg Bernarda, and Alan Smith. 2014. *Value proposition design*. Strategyzer Series. NJ: Wiley.

Ries, Eric. 2017. *The startup way*. New York: Currency, Penguin Random House LLC.

Stanley, Jeremy. 2017. "Data Science at instacart: Making on-demand profitable." Accessed May 2018. https://blog.dominodatalab.com/data-science-instacart/.

Stratigea, Anastasia, Chrysaida-Aliki Papadopoulou, and Maria Panagiotopoulou. 2015. "Tools and technologies for planning the development of smart cities." *Journal of Urban Technology* 22 (2): 43–62.

Täuscher, Karl, and Sven M. Laudien. 2017. "Understanding platform business models: A mixed methods study of marketplaces." *European Management Journal* 36 (3): 1–11.

Tukker, Arnold. 2015. "Product services for a resource-efficient and circular economy—A review." *Journal of Cleaner Production* 97: 76–91.

Van Alstyne, Marshall W., Geoffrey G. Parker, and Sangeet Paul Choudary. 2016. "Pipelines, platforms, and the new rules of strategy." *Harvard Business Review* 94 (4): 54–62.

van Dijck, José, Thomas Poell, and Martijn de Waal. 2018. *The platform society*. Oxford: Oxford University Press.

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