AMANDA NICOLE WILLIAMS

Make Our Planet Great Again

A Systems Perspective of Corporate Sustainability

Make Our Planet Great Again:
A Systems Perspective of Corporate Sustainability

Make Our Planet Great Again:
A Systems Perspective of Corporate Sustainability

Maak onze planeet weer groots:
Een systeem perspectief op duurzaam ondernemen

Thesis

to obtain the degree of Doctor from the
Erasmus University Rotterdam
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> "I am also reminded of what we all really know but sometimes forget. Opportunities are created by people and people respond to those opportunities. No-one owns that, no one is indispensable, all we can really do is try, at best, to make things happen. So I am with you through the history of the network and in spirit urging you on not to cease looking for and creating opportunities. Go for them with my blessing - own a piece and contribute a piece for others. In this way, we have a chance to make our group, our society and our planet better places."
>
> Nigel Roome, 2015

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Love,

Amanda Nicole Williams
Rotterdam
1 September 2018

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CHAPTER 1 INTRODUCTION

Donald Trump, the 45th President of the United States of America, was inaugurated on January 20th, 2017. He led his campaign with the slogan, '*Make America Great Again.'* On the campaign trail, Trump promised the American people to withdraw from the Paris climate agreement. Trump, a denier of climate change, claims that it was 'invented by the Chinese.' On November 6 2012, he tweeted, "The concept of global warming was created by and for the Chinese in order to make U.S. manufacturing non-competitive." He argued that adhering to the agreement would stifle American growth.

Since Trump has taken office, he has lived up to his promise regarding climate change. On June 1st, 2017, just months after taking office, President Trump announced that the U.S. will withdraw from the Paris Agreement. The Paris Agreement, ratified by 174 Parties, aims to "strengthen the global response to the threat of climate change" and to keep global temperature rise "well below 2˚C above pre-industrial levels" (United Nations, 2015). In his speech, Trump said the agreement, "was a bad deal for the U.S." and that, "as president, I can put no other consideration before the well-being of American citizens." Encouragingly, a number of local leaders have stepped up to fulfill the commitment to the Paris climate agreement. The former

mayor of New York, Michael Bloomberg, and the California Governor, Jerry Brown, spearheaded a coalition to bring together mayors, governors, and universities committed to climate action. On June 5th, 2017, they launched the "We Are Still In" statement to demonstrate that America would remain committed to the Paris Agreement (wearestillin.com, 2017). Over 2,500 leaders from city, county and state governments, businesses and higher education institutions have signed this pledge.

2,700 CEOs signed the "We Are Still In" pledge, including leaders from multi-national corporations such as Apple, IBM Corporation, Microsoft, NIKE, Philips Lighting, Royal DSM and Unilever. The companies "urged President-elect Donald J. Trump not to abandon the Paris climate deal, saying a failure by the United States to build a clean economy endangers American prosperity," (Tabuchi, 2016). Furthermore, 365 companies signed a joint letter from the United Nations Climate Change Conference, COP22, in Marrakech agreeing to cut carbon emissions (Tabuchi, 2016). The companies argued that stepping down from the agreement puts American prosperity and businesses at risk. They also argued that climate action can increase jobs and competitiveness (Tabuchi, 2016).

Paradoxically, in 2017, the U.S. faced an alarming number of natural disasters related to extreme weather and the effects of climate change (NOAA, 2018). Extensive wildfires broke out in the western United States and California during summer 2017, continuing into 2018. The wildfires have destroyed the livelihoods of many American citizens. Hurricane Harvey stormed the coast of Texas in late August causing widespread floods in the Houston metropolitan area. Hurricane Irma and Maria followed Harvey in September. Irma was the strongest storm in the Atlantic basin on record. Research shows that climate change increases the frequency and the magnitude of extreme weather events (IPCC, 2014). The National Oceanic and Atmospheric Administration (NOAA) tracked the weather and climate disasters and estimated a total damage of 306 billion USD during 2017, the costliest year on record (NOAA, 2018). Beyond doubt, extreme weather events threaten the livelihood of American citizens and the national economy.

In July 2017, the President of France, Emmanuel Macron, responded to Trump with the initiative, '*Make Our Planet Great Again'* (President de la Republique, 2017). The initiative promised to accelerate France's climate plan and urged others to maintain their own commitments. Macron offered *'Make Our Planet Great Again,'* grant*s* for climate scientists to continue their research in France. Notably, 13 of the 18 scientists to receive the grant are from the U.S. (Pain, 2017). Macron's response acknowledges that "we are ONE planet" (original emphasis) (President de la Republique, 2017). According to a report released in April 2017 by the Carbon Tracker Initiative, Climate Action Tracker, Potsdam Institute for Climate Impact Research and Yale University, if emissions continue to rise beyond 2020, then it is unlikely that the terms set in the Paris agreement will be attainable (Revill & Harris, 2017). Given the urgency of safeguarding our climate within three years, leadership and collective action are critical (Figueres et al., 2017). Efforts to improve the prosperity of one individual nation (particularly well developed countries with a higher environmental footprint than the carrying capacity of the planet) can no longer come at the expense of our entire planet (Raworth, 2012).

The stark contrast between Trump's campaign slogan and Macron's response is related to the topic of this thesis. In this thesis, I examine corporate sustainability from a systems perspective. A central insight of systems theory is that the individual components of a system interact and determine the behavior of the overall system (Meadows, 2009). Due to interconnections between subsystems, it is not possible to understand the behavior of the system by examining the individual components in isolation. A holistic understanding of the system is therefore essential. Suboptimization occurs when achieving the goals of a subsystem comes at the expense of achieving the goals of the broader systems. Trump's slogan and commitment to withdraw from the Paris agreement suggests short-term suboptimization of the American economy at the expense of broader systems. However, as Marcon responded, all of the subsystems that comprise a national economy are part of one global climate system. Meaning that an increase in emissions from one nation contributes to

climate change at a global scale and to the increase in frequency and magnitude of extreme weather events. Climate related extreme weather events feedback and the consequences are felt at regional and local levels.

Just as individual nations are embedded in broader systems, individual companies are also subsystems of broader social-ecological systems. The response from the business leaders to Trump's withdrawal from the Paris agreement shows that many companies are committed to the opposite. Whereas Trump is committed to short-term suboptimization of the American economy, companies expressed a commitment to reducing emissions with the motivation of reducing risks and increasing competitiveness. Therefore recognizing that the sustainability of the firm is interconnected with the viability of broader systems.

For decades, management scholars have conducted research to understand the relationship between corporations and the natural environment (Hoffman & Bansal, 2012). Theorization at the firm-level has provided valuable insights about the relationship between social and environmental activities and firm performance (Margolis & Walsh, 2003; Orlitzky, Schmidt, & Rynes, 2003), how firms balance stakeholder demands (Kassinis, 2012) and corporate eco-efficiency (Korhonen & Seager, 2008). Despite these useful advancements, little research has been conducted on the management of natural resources (George, Schillebeeckx, & Liak, 2015), that links "business processes to macro ecological processes and boundary conditions" (Whiteman, Walker, & Perego, 2013: 2). A growing number of corporate initiatives focus on managing ecosystem functions, however, organization studies have yet to fully tackle the interconnections between organizations and the natural environment (Porter, 2006; Winn & Pogutz, 2013). Therefore, I aim to contribute to the growing body of literature (Bansal & Song, 2017) that aims to understand the interconnections between organizations and broader social-ecological systems. In this thesis, I draw on insights from systems thinking to understand corporate sustainability from a nested systems perspective, which suggests that firms depend on society and the natural environment to thrive (Folke, Biggs, Norström, & Reyers, 2016; Marcus, Kurucz, & Colbert, 2010).

The structure of this introduction chapter proceeds as follows: First, I provide an overview of corporate sustainability research to position the contribution of this thesis within the field. Second, I state the aims and objectives of this thesis. Third, I introduce a nested systems perspective of corporate sustainability. Forth, I outline the structure of this thesis. Finally, I declare the contribution of others to this thesis.

Corporate Sustainability Research

Early research conceptualized sustainability from an embedded perspective with society "situated within the natural environment" (Bansal & Song, 2017: 108). This early research was marked by a special topic forum in the Academy of Management Review on 'Ecologically Sustainable Organizations.' In this special forum, researchers called for integration between management theory and the natural environment (Gladwin, Kennelly, & Krause, 1995) and for theories that recognize a firm's relationship with and constraints posed by the natural environment (Hart, 1995; Jennings & Zandbergen, 1995). They called to integrate systems thinking into corporate sustainability research (Gladwin et al., 1995; King, 1995; Shrivastava, 1995a; Starik & Rands, 1995) with a greater attention to assumptions of time and space (Purser, Park, & Montuori, 1995). Around the same time as this special topic forum, the Organization and Natural Environment (ONE) division formed in the Academy of Management.

Following the early calls for a systems view of sustainability, the firm-level became the main area of concern for researchers (Bansal & Song, 2017; Whiteman et al., 2013; A. Williams, Kennedy, Philipp, & Whiteman, 2017). These researchers treated firms as "discrete entities from macrosystems" (Bansal & Song, 2017), used mainstream organization based theories and employed quantitative theory testing (Bansal & Gao, 2006). Research covered topics such as strategic opportunities, costs and risks associated with environmental regulations and stakeholder pressures (Hoffman & Bansal, 2012).

One particular question, "Does it pay to be green?" received copious attention (Berchicci & King, 2007). This question considered if win-win relationships between business and the environment are possible, or if there is always a trade-off between business and environmental performance. This work considered how to manage market concerns with environmental issues to remain competitive (Hart, 1995; Hoffman & Bansal, 2012). Early evidence suggested that firms could benefit financially from voluntarily going beyond compliance with environmental regulations (Berchicci & King, 2007). In fact, competitive advantage rests on continuous innovation and improvement, rather than on efficiency and cost-minimization (Porter & Linde, 1995). Furthermore, corporations can increase financial profits by protecting the natural environment (Berchicci & King, 2007). Several meta-analyses also emerged from this stream of literature concluding that there is generally a positive relationship between environmental performance and financial performance (Margolis & Walsh, 2003; Orlitzky et al., 2003).

In response, several scholars raised concern if "Does it pay to be green?" is the right question to ask (Hoffman & Bansal, 2012). These scholars draw attention to the interconnections between organizations, society, and the natural environment. As a consequence, discussions on a systemic view of corporate sustainability and integration between organization theory and the natural environment are re-emerging (Bansal & Song, 2017; Whiteman et al., 2013; Winn & Pogutz, 2013). This work acknowledges the materiality of the natural environment (Hoffman & Bansal, 2012; Whiteman & Cooper, 2011) and argues that a blinkered focus on sustainability at the organizational level can ignore the functioning of broader systems (Levy & Lichtenstein, 2012; Roome, 2012). Important dynamics of broader systems such as feedback loops and interconnections influence sustainability across scales. The reemergence of a systemic view of corporate sustainability is demonstrated in paradox theory and systems research (Bansal & Song, 2017; A. Williams et al., 2017). Both perspectives call attention to the importance of temporal and spatial scales but differ concerning the relationship between business and broader systems. However, these two perspectives are not entirely separate in the literature.

A paradox perspective emphasizes the tensions in corporate sustainability between interrelated economic, environmental and societal dimensions (Hahn, Pinkse, Preuss, & Figge, 2014). The business case for sustainability rests upon a win-win argument, that by doing well for society, a business can also benefit. Paradox suggests that the tensions between business and society can persist (Bansal & Song, 2017) and need to be accepted (Hahn et al., 2014). Based on an integrative logic where different systems elements are simultaneously related, innovative solutions for sustainability can be developed (Bansal & Gao, 2006).

A systems perspective (see Chapter 2 for a review) emphasizes that businesses, societies, and ecosystems are interconnected across scales and that ecosystems provide the foundation for business and society to thrive. Systems perspectives argue that the separation between business and society is false (Bansal & Song, 2017) and focus on the holistic functioning of broader systems (Levy & Lichtenstein, 2012). They argue that the concept of sustainability only makes sense beyond the organizational level when considering how broader societal and ecological systems function (Gray, 2010; Roome, 2012). This is due to the fact that ecosystems are the foundation of human life, social justice and sustainable development (Folke et al., 2016). Furthermore, ecosystems are associated with boundary processes that must be respected to ensure "a safe operating space for humanity" (Rockström, Steffen, Noone, A. Persson, et al., 2009: 472; Whiteman et al., 2013). Research from a systems perspective suggests that by understanding how ecosystems function, organizations and societal well-being can be managed without degrading natural resources (Winn & Pogutz, 2013).

I seek to contribute to this growing body of systems literature in corporate sustainability research. Management scholars have long recognized the implications of embeddedness and the need to understand sustainability beyond the firm level. However, we know relatively little about the role of social-ecological sustainability frameworks in corporate sustainability practices. This thesis seeks to contribute to our

understanding of how corporate sustainability practices interact with broader systems including society and the natural environment.

Systems Thinking and Management Research

While a complete account of the influence of systems thinking in management research is outside the scope of this thesis, it is important to note, that while a systems perspective has been less influential in examining sustainability management research, the theory has permeated other areas of social science and management research. In fact, "systems approaches to understanding organizations and the construct of complexity each have long and respected heritages within management and organization studies" (Maguire, Allen, & McKelvey, 2011). Systems theory is traced as far back as the 1930s and received renewed attention with Scott's (2002) discussion on 'rational, natural and open systems (Maguire et al., 2011). This work draws on interdisciplinary roots and seeks to understand nonlinear aspects of organizational operations that are difficult to predict with formal models (Anderson, Meyer, Eisenhardt, Carley, & Pettigrew, 1999). Other influential areas of research such as the behavioral theory of the firm (Cyert & March, 1963) and sensemaking (Weick, 1979) also seek to incorporate elements of systems theory to their theoretical frameworks to acknowledge and capture the complexity of organization and social processes (Tsoukas & Dooley, 2011). For a more elaborate discussion on this topic, please refer to *The Sage Handbook of Complexity and Management* (Maguire et al., 2011).

Aims of the Dissertation

The aim of this dissertation is to contribute to our understanding of corporate sustainability. In order to contribute to the literature, I set three specific aims.

1. Review the literature at the intersection of corporate sustainability and systems thinking and highlight future research opportunities (Chapter 2).

2. Develop theoretical frameworks for conceptualizing corporate sustainability (Chapter 2), planetary risks (Chapter 3), and resilience (Chapter 4) from a systems perspective.
3. Demonstrate how global social-ecological sustainability frameworks are utilized in a global business association (Chapter 5).

Systems Perspective

A systems perspective of corporate sustainability forms the common thread underlying all the chapters of this dissertation. Issues of scale and embeddedness are central to a nested systems approach. I now discuss scale and embeddedness.

Spatial scale "is the geographical area in which the dominant process(es) of interest manifest," and temporal scale "refers to the patterned variations in processes over time," (Bansal, Kim, & Wood, 2018: 12). A systems perspective suggests that the dynamics of smaller scale systems can cascade up and influence the dynamics of larger scale systems, and vice versa (Gunderson & Holling, 2002). Issues at small or large scales may be outside of the range of organizational attention (Bansal et al., 2018). Similarly, issues which arise gradually over long periods may be more difficult to obverse (Walker & Salt, 2006). Failure to pay attention to subtle cues arising across spatial and temporal scales can leave the organization vulnerable to cross scale risks (Bansal & DesJardine, 2014; Whiteman & Cooper, 2011; see also Chapters 3 & 4). Therefore, a systems perspective seeks to understand and account for change across spatial and temporal scales.

A nested systems perspective implies that organizations and society are embedded in the natural environment drawing attention to the biophysical foundations of firm activity (Gladwin et al., 1995; Starik & Kanashiro, 2013). Collective firm behavior is constrained by the systemic limits of ecosystems, which when transgressed, increases the risk of adverse effects for human life (Rockström, Steffen, Noone, Å. Persson, et al., 2009; Whiteman et al.,

2013). However, firm activity is a likely contributor to the proliferation of risks associated with nearing the planetary boundaries (Shrivastava, 1995b; Whiteman et al., 2013; Whiteman & Williams, 2018). Therefore, organizations both cause and are affected by changes in broader social and environmental systems (Gunderson & Holling, 2002). Systems perspectives thus seek to understand the feedback loops and interconnections within and between nested systems.

Outline of Dissertation

The dissertation consists of five additional chapters including a systematic literature review, two conceptual chapters, an empirical chapter and a concluding chapter. In Table 1.1 I provide a summary of the contributions.

Chapter 2 reviews the literature at the intersection of systems thinking and sustainability management. A review of the literature demonstrates that research at this intersection has been limited in mainstream management journals with a majority of the research published in transdisciplinary journals. We argue that a "multidisciplinary systemic lens capable of appreciating the interconnectivity of economic, political, social and ecological issues across temporal and spatial dimensions" is crucial for a mature understanding of sustainability management (A. Williams et al., 2017: 866). We find that the literature is grounded in five core concepts including interconnections, feedback loops, adaptive capacity, emergence, and self-organization. Furthermore, research covers several research themes including behavioral change, leadership, innovation, industrial ecology, social-ecological systems, transitions management, paradigm shirts and sustainability education. Based on this analysis, we offer a framework for understanding sustainability from a systems perspective. Our framework suggests "future studies to explicitly recognize social-ecological embeddedness beyond the boundaries of the firm, industry, and product/process level, as well as the interconnections across multi-level, nested social-ecological systems" (A. Williams et al., 2017: 877). We conclude with avenues for future research. This chapter has been published

in the *Journal of Cleaner Production* (2016 Impact Factor of 5.715, 2017 Journal Citation Reports).

Chapter 3 suggests that a cross-scale systems perspective is valuable for studies of organizational resilience. We identify in Chapter 2 that most of the organizational resilience literature considers building organizational resilience in response to external threats. This literature considers the impact of social-ecological systems on the resilience of organizations with less consideration for cross-scale feedbacks. However, research suggests that organizations also impact the resilience of social-ecological systems (Clément & Rivera, 2016; King, 1995; Whiteman et al., 2013). We suggest that insights from natural science (Gunderson & Holling, 2002) can bridge the gaps in the extant literature. We develop several propositions related to cross-scale resilience for future research. This chapter is in the first round revisions stage at a management journal focused on societal issues.

Chapter 4 argues that "the complex role of organizations as collective contributors to and recipients of systemic risks at the planetary level is underexplored in organization studies" (Whiteman & Williams, 2018: 1). In Chapter 2, we find a group of emerging studies that theorize about the impacts of climate risks for managers (Beermann, 2011; Linnenluecke & Griffiths, 2010; Winn, Kirchgeorg, Griffiths, Linnenluecke, & Günther, 2011) and other research that examine risks to the natural world due to organizational accidents (Shrivastava, 1994a). However, we suggest that studies integrating planetary risks to and from collections of organizations are scarce. We present a three-stage framework for examining systemic planetary risks to address this gap. The three phases include: first, building a planetary view of organizational risk across scales, second, understanding planetary risks and third, building organizational and societal adaptive capacity for managing planetary risks. This chapter is forthcoming in The Routledge Companion to Risk, Crisis, and Emergency Management edited by Robert Gephart, Chet Miller, and Karin Svedberg Helgesson.

Chapter 5 provides an empirical account of how social-ecological sustainability frameworks are utilized in a global business association. Chapter 2 reviews the literature on social-ecological systems in

sustainability management research. The results found little prior research on the utilization of social-ecological sustainability frameworks. Given the capacity of collective business actions to impact macro-level systems, the need for managers to understand complex social-ecological systems is essential. Therefore, we ask the following question, "How are social-ecological sustainability frameworks utilized as a systemic basis for collective strategic planning and communication in a global business association?" To address this question, we conducted qualitative case study research at the World Business Council for Sustainable Development, a global business association that mobilizes around 200 multi-nationals to develop sustainable solutions. We identify eight phases of collective action for global sustainability related to the development and utilization of social-ecological sustainability frameworks. We found that the Planetary Boundaries Framework and the UN Sustainable Development Goals served as a basis for collective strategy setting and communication.

Chapter 6 concludes the dissertation. In this chapter, first, I state the main finding and contributions of each chapter. Second, I provide a synthesis of all the chapters. Third, I discuss the practical implications of this dissertation. Finally, I suggest avenues for future research.

Table 1.1 Summary of Contributions

Chapter 2
Reviews the literature and finds that literature at the intersection of sustainability management and a systems perspective lies outside of mainstream management journals
Identifies 5 core concepts (interconnections, feedback loops, adaptive capacity, emergence, and self-organization)
Identifies 8 research themes (behavioral change, leadership, innovation, industrial ecology, social-ecological systems, transitions management, paradigm shifts and education)
Demonstrates to what extent each of the research themes addresses cross-scale interactions and where gaps still exist
Develops a multi-level framework for future research

Chapter 3
Contributes a conceptual basis that examines resilience across temporal scales and across nested social-ecological systems which affect and are affected by organizational action
Chapter 4
Provides an overview of organizational risk literature *concerning the natural environment along two dimensions:* (1) We examined if environmental risks are considered at a discrete point in time or as a process that unfolds over time and space, (2) Then we considered the directionality of the threat
Provides a long-term, systemic perspective of planetary risks that recognizes the embeddedness of organizations in the natural environment
Proposes a three-phase framework for analyzing systemic planetary risks: (1) building a planetary view of organizational risk across scales, (2) understanding planetary risks, (3) building organizational and societal adaptive capacity for managing planetary risks
Chapter 5
We identify eight phases of collective action for global sustainability. During the four WBCSD led phases, the council utilized two social-ecological frameworks: (1) Developing a Long-Term Systems Perspective, *Vision2050* (2) Driving Action (3) Translating the SDGs for Business (4) Member company adoption of the SDGs
We also identify four phases related to the SDGs: (A) Triggering the Post-2015 Agenda (B) Science Input to the SDG Process (C) Business Input to the SDG Process (D)SDG Agenda
Our timeline identifies 27 significant meetings, 10 presentations, 4 speeches, the launch of 19 significant reports, and 36 important turning points during the development and utilization of two social-ecological sustainability frameworks
We find that the PBF was an effective framework for setting a collective corporate strategy grounded in science for global sustainability
We find that the SDGs was utilized for cross-organizational communication and reframing existing strategies
We contribute an empirical case about the role of social-ecological sustainability frameworks as a basis for collective strategy setting and communication in a global business association

Declaration of Contributions

This dissertation would not have been possible without the contribution of others. I now state my contribution to the five chapters of this dissertation and declare the contribution of others where appropriate.

I am the solo author of Chapter 1 and worked independently to produce this chapter. I incorporated feedback from the dissertation committee into the final version.

I am the lead author of Chapter 2 and collaborated with Steve Kennedy, Felix Philipp and Gail Whiteman to produce this chapter. I developed the research idea and question. Felix and I developed the research design, collected the data and coded the data together with input from Steve and Gail. I wrote the article with the help of Steve and Felix. Gail provided input and revisions. Kate Horton provided feedback before submitting to the journal. We included feedback from three anonymous reviewers. We published a version of this chapter in the *Journal of Cleaner Production* (See Williams, Kennedy, Philipp and Whiteman, 2017).

I am the lead author of Chapter 3 and collaborated with Gail Whiteman, the second author, and Steve Kennedy, the third author, to produce this chapter. I developed the research idea and question. I led the writing of the paper. I wrote the article with contributions from Gail and Steve. Kate Horton provided feedback. This chapter is currently in the first round of revisions at a journal.

I am a coauthor of Chapter 4 and collaborated with Gail Whiteman, the lead author. Gail developed the idea, the research question and wrote the introduction. I contributed to the literature review, the three-step framework, the discussion, and conclusion. We incorporated feedback from an editor, Robert Gephart. A version of this chapter is forthcoming in *The Routledge Companion to Risk, Crisis, and Emergency Management* edited by Robert Gephart, Chet Miller, and Karin Svedberg Helgesson.

I am the lead author of Chapter 5 and collaborated with Gail Whiteman. I collected all the interview data, documents (with the aid of a research assistant) analyzed the data and wrote the article. Gail Whiteman provided an ethnographic account of her involvement in the development of

Action2020 and feedback. Steve Kennedy provided feedback. A different version of Chapter 5 with Gail Whiteman and John Parker is currently under review. A separate article led by Gail Whiteman including three other collaborators, myself, John Parker, and Steve Kennedy utilized a portion of the same data. This article is also currently under review. Our discussions during this project fed into and influenced Chapter 5.

I am the solo author of Chapter 6 and worked independently to produce this chapter. I incorporated feedback from the dissertation committee into the final version.

Chapter 2 SYSTEMS THINKING: A REVIEW OF THE SUSTAINABILITY MANAGEMENT RESEARCH[1]

Abstract

Scholars from a wide range of disciplines and perspectives have sought to unravel the high complexities of sustainability. A mature understanding of sustainability management requires studies to adopt a multidisciplinary systemic lens capable of appreciating the interconnectivity of economic, political, social and ecological issues across temporal and spatial dimensions. Yet the field of systems thinking in the context of sustainability management research is disparate and can benefit from a comprehensive review in order to assimilate the current fragmented body of research and to identify promising research directions. To address this gap, we conducted a review of the systems thinking and sustainability management literature from 1990 up to 2015 including 96 articles. In this review, we first present descriptives that show an emerging body of work rapidly growing since 2011. We found that 54 percent of articles were published in two transdisciplinary journals, demonstrating that a systemic approach is not yet prevalent in mainstream management journals. Second,

[1] A version of this paper is published in *Journal of Cleaner Production:* Williams, A., Kennedy, S., Philipp, F., & Whiteman, G. 2017. Systems thinking: A review of sustainability management research. ***Journal of Cleaner Production***, 148(1): 866–881.

we identify and describe the core theoretical concepts of systems thinking found in the literature including interconnections, feedbacks, adaptive capacity, emergence, and self-organization. Third, findings show a number of research themes, including behavioral change, leadership, innovation, industrial ecology, social-ecological systems, transitions management, paradigm shifts and sustainability education. Finally, we offer a cross-scale integrated framework of our findings and conclude by identifying a number of promising research opportunities.

Introduction

In order to effectively address pressing societal issues such as climate change, social inequality, unemployment, and ecological degradation, scholars and managers can benefit from an enhanced understanding of the dynamic interactions within and across interconnected systems (Whiteman et al., 2013). Numerous management scholars have long recognized that the complexity of highly interdependent systems necessitates a systems approach, viewing social systems nested within natural systems and recognizing the dependency of business on nature (Gladwin et al., 1995; Marcus et al., 2010; Roome, 2012; Starik & Rands, 1995; Whiteman, Forbes, Niemelä, & Chapin, 2004). Gray (2010: 48) posits, "sustainability is a systems-based concept and, environmentally at least, only begins to make any sense at the level of ecosystems and is probably difficult to really conceptualize at anything below planetary and species levels." Despite these early and regular acknowledgments of the systemic character of sustainability, to date, a literature review of systems thinking as a theoretical lens to better understand sustainability management has not been conducted.

Reviews on sustainability research, of course, exist. However, these tend to focus on traditional management theories, such as the resource-based view, competitive strategy or institutional theory (Bansal & Gao, 2006; Berchicci & King, 2007; Etzion, 2007; Hoffman & Georg, 2012; Russo & Minto, 2012). While valuable, the theoretical perspectives covered in these reviews

do not explicitly address the interactions of firms with the social-ecological systems in which they are embedded. In contrast to insights from other disciplines, the current body of literature on corporate sustainability is "linearly focused on firm and industry effects" (Whiteman et al., 2013: 310) and lacks radical new insights (Bansal & Gao, 2006). Yet, an understanding of corporate actions in isolation from social-ecological systems is unlikely to address interconnected sustainability challenges (Marcus et al., 2010; Starik & Kanashiro, 2013; Walker et al., 2009; Whiteman et al., 2013). Systems thinking provides an antidote to such silos, as it offers a more holistic lens to examine the role of corporations within social-ecological systems.

Strains of systems thinking prevail in diverse scientific fields. Our review integrates systems perspectives from organization theory on sustainability with insights from systems thinking within ecology. Systems thinking is a way to understand the complexity of economic, social and ecological systems (Holling, 2001). A complex system is a set of interacting variables that behave according to governing mechanisms or forces (Maguire et al., 2011; Maguire, McKelvey, Mirabeau, & Oztas, 2006; Walker & Salt, 2006). Through the application of systems thinking, sustainability management researchers may be able to "identify the points at which a system is capable of accepting positive change and the points where it is vulnerable" (Holling, 2001: 392).

Interdependence between organizations and the natural environment is central to a systemic sustainability management perspective given that organizations depend on the natural environment for inputs and organizational actions directly impact the natural environment through feedback loops (Starik & Kanashiro, 2013; Starik & Rands, 1995). This embedded view of organizations recognizes systemic limits to growth within the boundaries of the planet, finite resources and the dependency of organizations on society, economy and nature (Gladwin et al., 1995; Marcus et al., 2010; Meadows, Meadows, Randers, & Behrens, 1972; Rockström, Steffen, Noone, A. Persson, et al., 2009; Whiteman et al., 2013; Winn & Pogutz, 2013). This leads us to ask the following question, "What do we

know about sustainability management research which leverages systems thinking as a theoretical lens?"

In this article, we present a systematic literature review addressing sustainability management from a systems thinking perspective to make sense of what is already known and provide directions for future research. First, we present the systematic review methodology. Second, we provide a descriptive analysis of the articles found in the review. Third, we give an overview of the core concepts and research themes. Fourth, we present an integrated framework of systems thinking and sustainability management. Finally, we discuss the implications for management research and provide directions for future research.

Research Methods

To ensure the rigor and quality of our review, the synthesis of the existing research was conducted in a systematic manner with the aim of reducing bias while allowing for flexibility and creativity (Tranfield, Denyer, & Smart, 2003). We designed our methodological approach based on insights from the stages of a systematic review suggested by Tranfield et al. (2003) and from literature reviews published in peer-reviewed journals (i.e. Aguinis & Glavas, 2012; Crossan & Apaydin, 2010; Fulmer & Gelfand, 2012; Klewitz & Hansen, 2014; Lockett, Moon, & Visser, 2006; Morioka & de Carvalho, 2016). This eight-step process (see Table 2.1) resulted in an initial sample of 1,711 papers and a final collection of 96 articles.

Search Process: Steps 1 to 6

Step 1: First we determined the need for a review on systems thinking as a multi-disciplinary lens to understand the complexities of sustainability management. We conducted an extensive search using Google Scholar and the Web of Science, Social Sciences Citation Index (SSCI). Our search indicated that no previous reviews were published on the topic.

Table 2.1 Systematic Review Method

Step 1 Determine relevance of the review	• Establish the need for the systematic review • Extensive search using Google Scholar and SSCI for past reviews
Step 2 Definition of temporal boundaries	• Include only articles published from 1990 up to 2015 • Use boundaries of previous reviews and salient events as a basis
Step 3 Definition of the search area	• Develop a list of peer-reviewed top management, specialty and practitioner journals • Identify relevant journals from previously published literature reviews in the field of management and prominent literature reviews published on sustainability management
Step 4 Development of search strings and inclusion/ exclusion criteria	• Develop two strings of keywords based on insights from previous systematic reviews on sustainability • Develop inclusion and exclusion criteria including relevance to sustainability management and theoretical contribution to systems thinking
Step 5 Choice of database and search mode	• Search using the Web of Science's Science Citation Index (SSCI) • Exclude book reviews, proceedings, editorial materials and notes • Limit search to titles and abstracts of the papers
Step 6 Develop article database	• First and second authors read the title and abstract of each paper and remove articles without a clear sustainability and systems thinking focus • Third author reviews the articles the first and second author did not agree on • Consult academic experts in the field to identify pertinent articles not captured by the keyword search
Step 7 Descriptive analysis	• Conduct a descriptive analysis to identify patterns and trends
Step 8 Thematic analysis	• Abductively code entire article texts according to systems thinking concepts and general article attributes using computer qualitative analysis software Nvivo • Identify organizational scholar use of core theoretical concepts of systems thinking and primary research themes

Step 2: Next we defined the temporal boundaries for the review. Our search included articles published from 1990 until the start of 2015. As with previous reviews, we selected to start our review in 1990 in accordance with significant events in the field. Etzion (2007) comments that following

the Rio de Janeiro Earth Summit in 1992 environmental issues became more salient. Similarly, Hoffman and Georg (2012) traced the history of the field and found that Business and the Natural Environment research emerged around 1990 in parallel with an emerging focus on environmental issues and changing managerial trends aimed at considering the environment as a strategic issue. In 1990, management scholars met to form the Organizations and the Natural Environment division at the Academy of Management and specialty journals such as *Business Strategy and the Environment* formed shortly afterwards (Hoffman & Georg, 2012).

Step 3: We further defined the search area by developing a list of top management, specialty and practitioner journals. The list of journals was determined by consulting published literature reviews in the field of management (i.e. Aguinis & Glavas, 2012) and prominent literature reviews on sustainability management (i.e. Bansal & Gao, 2006). We then compared this list with prominent journal rankings including the 4th Association of Business Schools journal list and Scientific Journal Rankings indicators. This resulted in 24 management journals, 11 specialty journals, and 3 practitioner journals, thus constraining our search to management literature. The final list of journals included in the review can be found in Table 2.2.

Step 4: We developed two keyword search strings. The first string was developed to capture articles relating to sustainability. We based the first string on a review published by Adams, Jeanrenaud, Bessant, Denyer, & Overy (2015) on the topic of sustainability oriented innovation and incorporated insights from other sustainability reviews that published their search strings. The following search string was used in the topic field of SSCI: sustainab* OR environmen* OR green OR ecol* OR adapt* OR resilien* OR responsib* OR triple bottom line OR cradle OR soci* OR ethic*.

The second search string was developed to capture articles related to systems thinking. We read published articles relating to sustainability and systems thinking to identify fundamental concepts. Then we developed the keywords for this second string in discussions amongst the authors of this

paper. This led to the following search string that was used in the topic field of SSCI: system* theory OR system* thinking OR complex* OR holis*. A first search using the term 'system*' returned a cumbersome 5,343 articles, largely falling outside the scope of this review. This was refined by adding the terms 'theory' and 'thinking' to 'system*' in order to capture articles making theoretical contributions and keep the boundaries of the review manageable. To be considered for further inclusion in the review, articles needed to contain one term from the first string and one term from the second string in the title or abstract.

Table 2.2 Targeted Journals

Category	**Journals**
Management Journals	Academy of Management Annals, Academy of Management Journal, Academy of Management Perspectives, Academy of Management Review, Administrative Science Quarterly, British Journal of Management, European Management Review, International Organization, Journal of Applied Psychology, Journal of International Business Studies, Journal of Management, Journal of Management Studies, Journal of Organizational Behavior, Long Range Planning, Management and Organization Review, Management Science, Organization Science, Organization Studies, Organizational Behavior and Human Decision Processes, Organizational Research Methods, Personnel Psychology, Research Policy, Strategic Management Journal, Strategic Organization
Specialty Journals	Accounting, Auditing & Accountability Journal, Accounting Organizations and Society, Business & Society, Business Ethics Quarterly, Business Strategy and the Environment, Corporate Governance, Journal of Business Ethics, Journal of Cleaner Production, Journal of Industrial Ecology, Leadership Quarterly, Organization & Environment
Practitioner Journals	California Management Review, Harvard Business Review, Sloan Management Review

Inclusion and exclusion criteria to decide which articles would be accepted in the review were also developed in this step in discussion between the authors of this paper. Articles with a focus on sustainability management and systems thinking were selected for the review. We now

give examples of when search terms returned irrelevant articles. An article suggested for inclusion in the review because it contained the term 'responsible' in the abstract, referring to the responsibility of work teams would be removed for further consideration because it lacked a sustainability focus. Articles that included the term 'environment' in the abstract referring to general business environments (instead of environmental sustainability or the natural environment) were also removed. Considering the focus on systems thinking, articles that contained the term 'complex', such as complex problem solving, were removed due to a lack of use of complexity theory.

After removing articles without a clear focus on sustainability management and systems thinking, we noticed many articles that made a methodological contribution as opposed to a theoretical contribution. Given that literature reviews have already been published focusing on methods (i.e. Angelakoglou & Gaidajis, 2015; Chang, Lee, & Chen, 2014; Ibáñez-Forés, Bovea, & Pérez-Belis, 2014) we decided to further refine our inclusion criteria. Articles that made a theoretical contribution to the field were included in the review, while articles that made a practical or methodological contribution were excluded from the review. For example, we removed articles that solely evaluated the environmental impact of a product or conducted a life cycle assessment (practical) or aimed to improve agent based modeling methods (methodological).

Step 5: We conducted our search using SSCI. To ensure the quality of the articles in the review and to keep the review manageable, we limited our search to peer-reviewed journal articles and excluded non-peer reviewed options including book reviews, conference proceedings, editorial materials, and notes. The keyword search strings we developed in Step 4 were run on titles and abstracts in SSCI. This search identified 1,711 potentially relevant articles for the review.

Step 6: We began to develop a database of articles by screening titles and abstracts. To ensure the reliability of the review, three co-authors were involved in the screening of the articles. Two authors reviewed the title and abstract of each article coding either 'accept', 'reject' or 'further review'

based on the inclusion criteria. A third author reviewed any articles coded 'further review' or in which the coding of the other co-authors did not match e.g. articles that were coded as 'accept' by one author and 'further review' or 'reject' by the second. Articles that were still considered for inclusion underwent full text analysis, conducted by two authors, with a third co-author again reviewing any cases of disagreement. This process reduced the number of articles to be included in the review to 80.

Finally, in this step, we consulted academics in the field to recommend any articles that had not been identified in the review. These consultations were held during presentations of the review and through the release of early drafts of this article. This procedure was undertaken to ensure that our keywords did not overlook any pertinent articles. This resulted in an additional 16 articles added to the review.

Descriptive and Thematic Analysis: Steps 7 to 8

Step 7: We then conducted a descriptive analysis of the papers covered in our review. The descriptives are found in Section 3.

Step 8: As a final step we conducted a thematic analysis. We abductively coded all articles, alternating between inductive and deductive coding. The general deductive codes included: level of analysis, contribution to what literature, empirical or conceptual, methods used and sources of data. The theoretical deductive codes derived from the literature included: conceptualization of business-society interface (Marcus et al., 2010), anthropocentrism versus ecocentrism (Purser et al., 1995) the adaptive cycle, social-ecological systems (Gunderson & Holling, 2002) and systems thinking dimensions such as feedback loops, hierarchical systems, delays, flows, intervention, dynamic equilibrium and self-organization (Meadows, 2009). A list of these codes including definitions was developed by the co-authors and made available for reference during the coding.

In addition to these predetermined codes, other relevant codes emerged such as industrial symbiosis, innovation, paradigm shifts, decision making and tools to enable a systemic understanding of sustainability. The coding of the articles was completed using Nvivo, a computer software for

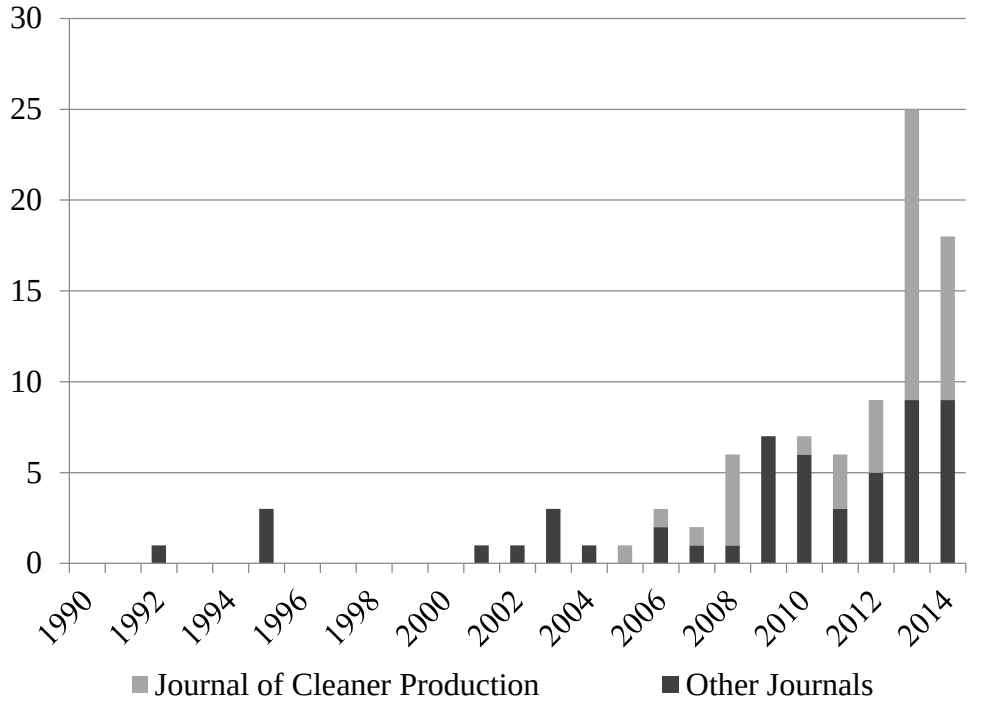
qualitative data analysis. The authors discussed different approaches for presenting the results of the review and presented the paper at three international conferences to receive feedback. This ultimately resulted in 5 core theoretical concepts and 8 research themes, which are presented in Section 4.

Descriptives

From 1990 until 2000, articles published pertaining to systems thinking and sustainability management were limited, averaging less than one article published per year (see Figure 2.1). Since 2000, the number of articles published per year has increased exponentially with 67 of our 96 reviewed articles becoming available from 2010.

The *Journal of Cleaner Production* is highlighted in our review as the leading publication outlet for sustainability management research from a systems perspective (see Figure 2.1). From the *Journal of Cleaner Production*, 41 articles were identified, and another 11 from a fellow transdisciplinary journal, the *Journal of Industrial Ecology*. Despite the mainstream publication of early conceptual articles calling for a systemic or ecological paradigm (Gladwin et al., 1995; Starik & Rands, 1995), we found few articles in these types of management journals, such as *Journal of Business Ethics* (10), *Organization & Environment* (6), *Research Policy* (5), *Business Strategy and the Environment* (4), *Academy of Management Review* (4), *Organization Science* (2), *Journal of Management Studies* (1) and *Strategic Management Journal* (1). This distribution suggests that while a systems perspective on sustainability management is well accepted in the transdisciplinary journals, which include disciplines well versed in systems thinking such as environmental sciences and engineering, it is yet to be a regular feature in journals solely focused on mainstream management. In addition, we highlight that mainstream 'environmental management' journals such as *Organization & Environment* and *Business Strategy and the Environment* also appear to have few articles published with a systemic lens.

Figure 2.1 Distribution of Publications (per year)



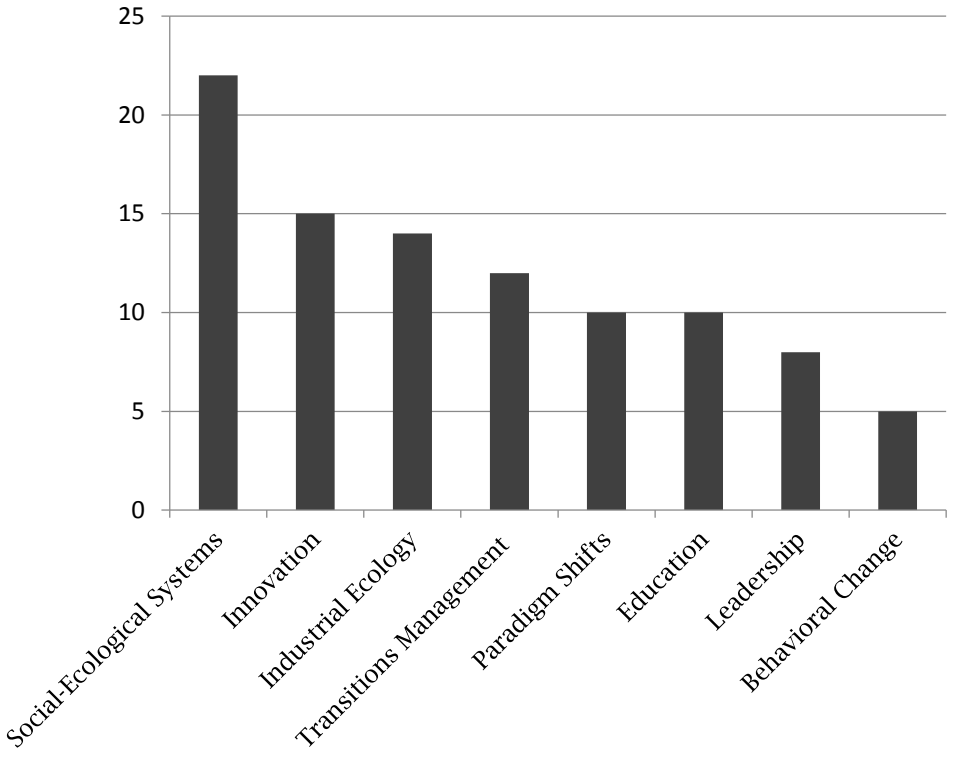
Using citation statistics from SSCI, we present a list of the top 20 cited articles in the review from most to least cited (see Table 2.3). The top cited articles come from a variety of sources including *Research Policy, Academy of Management Review, Journal of Business Ethics, California Management Review, Accounting Organizations and Society, Journal of Cleaner Production, Journal of Industrial Ecology, Organization Science, Journal of Management Studies and Organization & Environment*. *Journal of Cleaner Production* represents 7 of the top 20 cited articles.

Table 2.3 Top Cited Articles

Authors, Year	Journal
(Geels, 2002)	Research Policy
(Gladwin et al., 1995)	Academy of Management Review
(van Marrewijk, 2003)	Journal of Business Ethics
(Starik & Rands, 1995)	Academy of Management Review
(Sterman, 2001)	California Management Review
(Gray, 2010)	Accounting Organizations & Society
(Lozano, 2008)	Journal of Cleaner Production
(Jänicke, 2008)	Journal of Cleaner Production
(Vanloqueren & Baret, 2009)	Research Policy
(Coenen, Benneworth, & Truffer, 2012)	Research Policy
(Bocken, Short, & Rana, 2014)	Journal of Cleaner Production
(Lozano, 2012)	Journal of Cleaner Production
(Lozano et al., 2013)	Journal of Cleaner Production
(Lozano, 2010)	Journal of Cleaner Production
(Rotmans & Loorbach, 2009)	Journal of Industrial Ecology
(Boons et al., 2013)	Journal of Cleaner Production
(Mahoney, McGahan, & Pitelis, 2009)	Organization Science
(Whiteman et al., 2013)	Journal of Management Studies
(King, 1995)	Academy of Management Review
(Starik & Kanashiro, 2013)	Organization & Environment

In terms of research themes (see Figure 2.2), we found most of the published articles addressed social-ecological systems (22), innovation systems (15), industrial ecology (14) and transitions management (12). Research themes with fewer articles include paradigm shifts (10), education (10), leadership (8) and behavioral change (5).

Figure 2.2 Distribution of Publications per Research Theme



We found that the majority of the articles, 53 percent, were conceptual, while 47 percent of the articles were empirical. The empirical articles used a variety of methods. Notably, 47 percent of the empirical articles used case study methodology, and 4 articles combined case study research with other approaches such as action research, cross-case comparison, survey research and grounded theory. Other methodologies adopted included statistical analysis, factor analysis, hypothesis testing, backcasting, agent based modeling and material flow analysis.

Research results

We begin by defining sustainability from a systems perspective. Sustainability is a trans-disciplinary concept that requires insights from several scientific fields to fully understand due to interconnections across

economic, social and environmental systems. This holistic view of sustainability requires reconciling ontological and epistemic issues across environmental, social and managerial sciences (Vildåsen, Keitsch, & Fet, 2017).

The environmental dimension of sustainability is grounded in positivism and assumes that the natural world exists and can be perceived through empirical methods. While the social dimension of sustainability is more closely related to subjective values of social constructivism and that social reality is constructed through social interactions. And finally, the economic dimension of sustainability spans both positivist and alternative scientific paradigms.

Sustainability is not an end state that can be achieved, but a 'moving target' that is continuously changing and improving (Gaziulusoy, Boyle, & McDowall, 2013). This dynamic state exists within environmental thresholds, defined by the *planetary boundaries framework,* or the "safe operating space for humanity" (Rockström, Steffen, Noone, A. Persson, et al., 2009: 472; Steffen, Richardson, et al., 2015). While social boundaries are more difficult to quantify, research suggests several dimensions of social sustainability to consider including health, equality, education, and a decent living (Raworth, 2012). International political frameworks, such as the UN Sustainable Development Goals, also identify social issues to consider while progressing towards sustainability. Therefore, a path of sustainable development exists in a safe space environmentally and a just space socially (Leach, Raworth, & Rockström, 2013). From a systems perspective, sustainability is the ability of systems to persist, adapt, transform or transition in the face of constantly changing conditions within a safe and just space.

Systems thinking is a useful lens to understand change across scales. Scale is "the spatial, temporal, quantitative, or analytical dimensions used to measure and study any phenomenon," and levels of analysis are "the units of analysis that are located at different positions on a scale" (Cash et al., 2006: 2). A holistic understanding, including spatial and temporal conditions, is critical for advancing towards sustainability and avoiding

tradeoffs that result in unintended consequences (Metson, Aggarwal, & Childers, 2012).

Core Concepts

In this section, we provide an overview of the core theoretical concepts that have been used to understand sustainability from a systems thinking perspective. In Table 2.4, for each core concept, we provide a short description from the literature, representative articles, and future research questions.

Interconnections

Interconnected parts in systems determine the behavior of the system as a whole (Merali & Allen, 2011). The value of a systems thinking approach to sustainability issues springs from consideration of the dynamic interconnections between networks of actors across scales in social, economic and ecological systems (Davis, Nikolić, & Dijkema, 2009; Freedman, 1992; Gladwin et al., 1995; Hoffman, 2003; Lozano, 2008; Valente, 2012). Sustainability managers are faced with balancing the relative autonomy and self-preserving tendencies of organizations, with recognizing their roles and responsibilities as part of wider systems (van Marrewijk, 2003). Organizations hold mutual relationships of impact and dependence with larger and smaller systems that offer services critical to their ability to create value, for example, human and material resources or supporting ecological services such as water cycling (Winn & Pogutz, 2013).

Understanding interconnections is important for leaders of organizations and for the management of complex systems in order to achieve sustainability (Metcalf & Benn, 2013). Understanding interconnections within industrial ecosystems can improve industrial symbiosis (Tsvetkova & Gustafsson, 2012) and closed-loop manufacturing processes (Ashton, 2009), while cross-scale impacts and systems transitions can occur when products are innovated with consideration of interconnections between product components and social-technical

systems (Boons et al., 2013). However, determining the behavior of a system is complex due to interconnections between systems variables that manifest over time and space leading to difficulty in decision making (Kunz, Moran, & Kastelle, 2013a). For instance, an ecosystem service may generate benefits far away from the source and long after the service is provisioned (Winn & Pogutz, 2013).

Feedback Loops

Feedback loops are, "The secondary effects of a direct effect of one variable on another, they cause a change in the magnitude of that effect. A positive feedback enhances the effect; a negative feedback dampens it" (Walker & Salt, 2006: 163). Feedback loops cause systems to be interconnected (Kunz et al., 2013a) and when the consequences of feedbacks loops are not fully understood by managers, unpredictable system behavior can emerge (Allenby, 2009). In response to feedback from the external environment, systems adapt or transform (Folke et al., 2002; Holling, 2001) and have direct and indirect impacts on organizations (Winn et al., 2011).

Sterman (2001: 12) explains the implications of feedback loops for managers: "our decisions alter the state of the world, causing changes in nature and triggering others to act, thus giving rise to a new situation which then influences our next decision." Managers actively create and then react to feedback loops (Whiteman et al., 2004). As managers respond to improving indicators of sustainable progress, positive feedback loops are created, further advancing sustainability (Starik & Kanashiro, 2013). When managers fail to make sense of feedback loops and respond accordingly, the system may become vulnerable, therefore jeopardizing resilience (Whiteman et al., 2013). With an understanding of feedback loops, the consequences of decisions are evident and system behavior can be managed as opposed to reacting passively to system changing events (Sterman, 2001).

Adaptive Capacity

The ability of actors in a system to maintain basic structure and manage resilience represents the adaptive capacity of the system (Ehrenfeld, 2007;

Holling, 2001; Walker & Salt, 2006; Whiteman et al., 2004). Resilience is, "the amount of change a system can undergo (its capacity to absorb disturbance) and remain within the same regime—essentially retaining the same function, structure, and feedbacks" (Walker & Salt, 2006: 163). Adaptive capacity suggests that managers and complex systems continuously learn from their experience (Ferreira, Lopes, & Morais, 2006; Sterman, 2001; Valente, 2010). When managers adapt to these learnings, competitiveness, resilience, and survival are improved (Valente, 2010). If an environmental crisis strikes, adaptive capacity is enabled to effectively manage the disruption (Beermann, 2011).

To build the adaptive capacity of a firm, managers can innovate new business models or ways of organizing to cope with change in complex systems (Beermann, 2011). Managers may also build adaptive capacity by engaging in transformative learning processes (Folke et al., 2002; Manring, 2014). Transformative learning processes include learning to deal with change, enhancing diversity, systems level learning and creating conditions for self-organization to emerge. However, firms may need to manage tensions between building adaptive capacity and considerations of efficiency that espouse the conflicting aims of low diversity and standardization (Hahn, Reimsbach, & Schiemann, 2015).

Emergence

Emergence occurs in complex systems when novel higher level structures and patterns arise due to interaction between systems variables (Rotmans & Loorbach, 2009). The constant adaption to complex feedback loops and co-evolution of organizations with their environments (Porter, 2006) without a central organizing agent, drives the emergence of systems dynamics, structures, and self-organization (Batten, 2009; Dougherty & Dunne, 2011; Rotmans & Loorbach, 2009; Sterman, 2001). The emergent patterns, whether on a global, regional or local level, arise from interacting subsystems: the actions and decisions of companies and individuals alike (Huo & Chai, 2008; Kunz, Moran, & Kastelle, 2013b).

The emergence of sustainable industrial systems may be facilitated by systems dynamics modeling and improved decision making (Romero & Ruiz, 2013). The emergence of sustainability oriented innovations can create opportunities for problem solving and information flows (Dougherty & Dunne, 2011). However, rigid organizational structures can also stifle the emergence of sustainability oriented innovations (Dougherty & Dunne, 2011) and constrain personal sustainability agendas of employees (Hahn et al., 2015). The emergence of post-conventional consciousness in managers can foster corporate greening but the factors leading to this emergence are unknown (Boiral, Baron, & Gunnlaugson, 2014).

Self-organization

Self-organization is, "the ability of a system to structure itself, to create new structure, to learn, or diversify" (Meadows, 2009: 188). Complex adaptive systems are able to self-organize, learn from their experience and adapt to changes in the external environment (Ashton, 2009; Rotmans & Loorbach, 2009). Self-organization arises when dynamics, patterns, and structures emerge within the internal structure of a system without outside control (Batten, 2009; Freedman, 1992; Sterman, 2001). Patterns in systems at the global level emerge due to self-organizing dynamics of interacting lower level systems (Batten, 2009). Self-organized emergence is enabled when the system is pushed out of equilibrium (Dougherty & Dunne, 2011). Self-organization occurs internally in a system and is driven by external energy (Rotmans & Loorbach, 2009). Self-organizing processes require patience and trust (Nevens, Frantzeskaki, Gorissen, & Loorbach, 2013). Transformative learning can create opportunities for self-organizing processes towards sustainability (Manring, 2014)

Table 2.4 Core Concepts

Short Description	Articles	Future Research
Interconnectedness		
Organizations are agents in interconnected systems, recognition of the complexity of interconnected social and ecological problems is critical	(Davis et al., 2009) (Metcalf & Benn, 2013) (Sterman, 2001) (Valente, 2010, 2012)	Develop conceptual models to understand connections What tools can help leaders identify interconnections that close loops in industrial networks?
Feedbacks		
Interaction with and reaction to feedbacks causes nonlinear dynamics and the emergence of complex behaviors over time. Understanding feedbacks as underlying governance mechanisms can inform decision making.	(Sterman, 2001) (Valente, 2010) (Whiteman et al., 2004)	Develop methods to understand the impact of long-term social-ecological feedbacks Analyze the impacts of indirect social-ecological feedbacks on the resilience of the firm
Adaptive Capacity/ Resilience		
Adaptive capacity ensures the survival of the system when agents learn from their experience and act accordingly. Organizations must adapt to changing environmental conditions	(Ashton, 2009) (Beermann, 2011) (Valente, 2010) (Winn et al., 2011)	Determine the thresholds between adaptive capacity and transformation Examine the costs and benefits of building long-term resilience
Self- Organization		
Self-organizing systems develop their own structure and behavior spontaneously without being guided from the top-down. Self-organization leads to emergence in complex adaptive systems	(Batten, 2009) (Sterman, 2001) (Rotmans & Loorbach, 2009) (Whiteman et al., 2013)	Identify what micro-processes underlie self-organization in social systems Determine the cross-scale impacts of self-organization
Emergence		
Emergence is the result of lower level interactions when the system is pushed out of equilibrium. Existing structures can hinder emergence	(Dougherty & Dunne, 2011) (Ehrenfeld, 2007) (Huo & Chai, 2008)	Understand what conditions lead to emergence enabling disequilibrium When does self-organization lead to the emergence of sustainable innovations?

Summary of Core Concepts

We have presented the core concepts independently, however, they are interrelated. System components are *interconnected* due to *feedback* loops (Kunz et al., 2013a). Understanding interconnected components of a systems allows the dynamics of the system as a whole to be understood (Merali & Allen, 2011). *Self-organization* drives higher level *emergent* structures and processes (Dougherty & Dunne, 2011; Rotmans & Loorbach, 2009). At the macro-level, *adaptation* of the whole system is determined by local-level processes of *self-organization* and *emergence* (Merali & Allen, 2011).

Research Themes

We found eight different research themes that apply a systems thinking lens to understand sustainability management (see Table 2.5). They are presented here in order of scale starting with the individual level.

Behavioral Change

Scholars argue behavioral change and a revolution of mindsets is crucial to transforming business and society, taking concrete action (Marcus et al., 2010) and driving systemic change (Raivio, 2011). Behavioral change may be necessary because individual behavior aggregates to drive systems dynamics in business and society (Marcus et al., 2010). Studies at the local community level give insight into how individuals can be collectively engaged and how their behavior can be influenced based on their personal connection to local conditions (Nevens et al., 2013).

Scholars have used a cognitive framing lens to explore an integrative perspective of managerial processes that account for temporal and spatial dimensions of sustainability across multiple scales (Bansal & DesJardine, 2014; Hahn et al., 2015). From this logic of focusing on paradoxes and tensions in sustainability, managers are stimulated to understand interconnections between system elements and their decisions over time

(Gao & Bansal, 2013). Furthermore, scholars posit that cognitive diversity may play a role in large scale systemic change (Hahn et al., 2014).

Sustainable consumption patterns are dependent on the values and decisions of individual citizens (Raivio, 2011). Transformation of consumptions patterns is crucial given planetary limits (Vinkhuyzen & Karlsson-Vinkhuyzen, 2014) but current attempts are failing (Doyle & Davies, 2013). Behavioral incentives that may drive sustainable consumption remain fuzzy (Vinkhuyzen & Karlsson-Vinkhuyzen, 2014) and extant research has yet to give due consideration to how consumption patterns are embedded in social-cultural and technological systems (Doyle & Davies, 2013).

Leadership

Research suggests sustainability leadership presupposes extraordinary capabilities and a holistic perspective on the complexities of embedded organizations (Lozano, 2012; Metcalf & Benn, 2012, 2013; Painter-Morland, 2008). Taking a holistic perspective may require managing large amounts of complex information while avoiding the tendency to reduce and narrow data for decision-making (Metcalf & Benn, 2012). The ability of a leader to maintain a long-term focus (Boiral et al., 2014), incorporate different viewpoints and allow for decentralized decision making were also found to be important (Wong, Ormiston, & Tetlock, 2011).

While traditional leadership theories rest on concepts of intentional influence, control and direction by a leader towards a predefined organizational goal (Yukl, 2008), research on complex systems and leadership stresses unpredictability, emergence and resilience, and the need to integrate and reconcile multiple conflicting goals (Boiral et al., 2014). A systems approach suggests that responsibility is shared among all members and the aim of leaders is to build value-driven organizations (Painter-Morland, 2008).

Innovation

To address systemic challenges and enable transformative change, scholars of this research theme posit that radical innovation in education, products, services, production systems, logistic systems and business models is needed (Boons & Lüdeke-Freund, 2013; Boons et al., 2013; Jänicke, 2008; Loorbach & Wijsman, 2013; Winn et al., 2011). Innovating for sustainability is a systemic, dynamic and nonlinear process that faces many uncertainties (Foxon & Pearson, 2008).

Considering the implications of sustainability oriented innovations for the firm, extant literature shows managers must understand the relationship between sustainable process, product, and organizational innovation to manage business performance (Cheng, Yang, & Sheu, 2014). For example, interactions between product innovation and process innovation in energy efficiency must be understood to improve the sustainability practices of a firm (Gerstlberger, Knudsen, & Stampe, 2014).

Innovations of new sustainability oriented products and services are viewed as the result of complex interactions between many firms (Dougherty & Dunne, 2011). Knowledge and resources for innovation can be dispersed among industry actors (Dougherty & Dunne, 2011), and their success depends on prior efforts of technical advancement and unlocking changes in the marketplace. Organizational networks should be formed to encourage interactions between firms and connect disparate ideas (Dougherty & Dunne, 2011). Jänicke (2008) explains how complex networks of firms can also serve to increase pressure on firms with poor sustainability performance to innovate as they face growing insecurity over societal and governmental governance risks. Developing a systems understanding of supply chains can also provide great opportunity for sustainability oriented innovations and enhance business performance (Isaksson, Johansson, & Fischer, 2010). Tools such as life cycle analysis may improve sustainable product development between firms (Gmelin & Seuring, 2014; Luthe, Kägi, & Reger, 2013).

Firm innovations, such as innovative business models, seek to go beyond the techno-fix approaches to sustainability and offer opportunities to significantly change the way a business creates, delivers and captures value (Bocken et al., 2014). An emerging literature stream is considering how changes in business models may lead to changes in the interconnected larger production and consumption systems (Boons et al., 2013). Such interconnections between micro-level product innovation and macro-level societal transformation can be understood using double-flow scenario methods or explorative backcasting scenarios (Gaziulusoy et al., 2013).

Industrial Ecology

Industrial Ecology research examines the flows of energy and materials within industrial systems with the aim of understanding systemic emergent behavior of integrated human-natural systems such as eco-industrial parks. Eco-industrial parks aim to increase productivity while simultaneously providing collective solutions to environmental problems through geographical clustering of organizations and coordination of material, energy and information flows (Allenby, 2009; Behera, Kim, Lee, Suh, & Park, 2012; Huo & Chai, 2008). Eco-industrial parks may also have wider impact to promote and be used as levers for implementing sustainable policies at the regional level (Cerceau et al., 2014).

Scholars view modeling of eco-industrial parks as critical to improving decision making and fostering industrial symbiosis (Despeisse, Ball, Evans, & Levers, 2012; Huo & Chai, 2008; Romero & Ruiz, 2013). Yet, a more holistic approach to industrial ecology could benefit the field (Ashton, 2009; Hoffman, 2003; Metson et al., 2012). Ashton (2009) found that the recognition of interconnections between human and natural systems introduces new institutional variables to the analysis of industrial ecosystems. A more holistic approach to industrial ecology can expand the field from a set of tools to understand material and energy flows to address more profound challenges in social-technical landscapes (Allenby, 2009).

To better understand the social-technical landscape, a combination of insights from industrial ecology and complexity science can help managers make decisions and address complex sustainability problems (DeLaurentis & Ayyalasomayajula, 2009; Ehrenfeld, 2007). Integrative research and interdisciplinary learning are also needed to develop frameworks of interconnected industrial-social-ecological systems (Ramaswami et al., 2012).

Social-ecological Systems

The social-ecological systems perspective recognizes the interconnections between business and society, which are both nested in natural systems defined by biospheric limits (Marcus et al., 2010; Whiteman et al., 2013). A social-ecological system is an "integrated system of ecosystems and human society with reciprocal feedbacks and interdependence" (Folke et al., 2010: 3). Studies within this research theme seek to deepen understanding of organizational dependency on social-ecological foundations (Winn & Pogutz, 2013) and posit that when managers understand the complex dynamics of social-ecological systems, its management may be improved (Kunz et al., 2013b). New partnership models and collaborative solutions are seen to drive systemic solutions for complex sustainability problems (Hodge, 2014; Mahoney et al., 2009; Nidumolu, Ellison, Whalen, & Billman, 2014).

Organizations adapt to changes in social-ecological systems, such as environmental crises driven by climate change which has been given special attention by scholars (Linnenluecke & Griffiths, 2010; Paschen & Ison, 2014; Winn et al., 2011). Direct and indirect impacts of climate change create an uncertain environment for managers (Beermann, 2011). Organizations may apply resilience thinking to help manage the impacts of climate change by identifying climate risks and opportunities (Beermann, 2011; Ortiz-de-Mandojana & Bansal, 2016; Winn et al., 2011). While research has focused on considering the impact of social-ecological system changes on organizational resilience, few studies explore the impact of firms on

ecological systems and the services they provide organizations (Whiteman et al., 2013; Winn & Pogutz, 2013).

Transitions Management

When systems fail or become path dependent different actors may choose to intervene (Foxon & Pearson, 2008; Mahoney et al., 2009; Vanloqueren & Baret, 2009) to initiate systems change towards sustainability (Doyle & Davies, 2013). Research on transitions management (Vries & Riele, 2006), seeks to understand long-term systems change processes of niche sub-systems (Rotmans & Loorbach, 2009) and societal systems (Loorbach, Bakel, Whiteman, & Rotmans, 2009). Policy interventions are shaped by the dynamics of social-technical systems (Hoppmann, Huenteler, & Girod, 2014) and policy tools can help facilitate transitions to low-carbon energy economics (Könnölä, Unruh, & Carrillo-Hermosilla, 2007).

Cities, when viewed as complex adaptive systems can undergo urban transitions towards sustainability stimulated by entrepreneurial change agents (Block & Paredis, 2013; Uyarra & Gee, 2013). Network governance may help improve decision making in city level transitions (Khan, 2013). Creating public urban spaces for entrepreneurial activity provides a low-risk common space for social and environmental innovations to develop (Radywyl & Biggs, 2013). During the collaborative innovation process, learning processes occur to support the firms in effective action (Nevens et al., 2013). The alignment of principles across scales can lead to higher-order systemic change (Perey, 2014).

Paradigm Shifts

Scholars posit that a change in worldview is essential to sustainable development progress (Seiffert & Loch, 2005; Shin, Curtis, Huisingh, & Zwetsloot, 2008). Paradigm shifts in the field of management can be seen as the result of larger shifts at the societal level (Valente, 2010). Criticism from society about the role of business in society has also driven paradigm changes towards sustainability (Valente, 2012). Management scholars demonstrate a change in worldviews, values and paradigms from a

reductionist to an integrative perspective (Gladwin et al., 1995; Shrivastava, Ivanaj, & Persson, 2013) or from a neoclassical mechanistic to a systemic perspective (Seiffert & Loch, 2005; Stormer, 2003).

Education

Research found in the education theme suggests that scientific paradigm shifts challenge the conceptual foundations of educational systems and call for the integration of sustainability into curricula for all ages (Raivio, 2011). Lozano (2010) found that university leaders in sustainability education lack a holistic transdisciplinary approach. Adoption rates of sustainability curricula may be increased if the contribution to sustainable progress is demonstrated (Watson, Lozano, Noyes, & Rodgers, 2013). Yet, Dlouha et al. (2013) suggest it is difficult to demonstrate success because the social and political impacts of educational transformations are difficult to measure due to the fluid nature of transformation processes.

Research could consider pedagogical approaches for driving changes towards sustainability in organizations or society. Developing skills for holistic thinking was found to be important in most research (Ferreira et al., 2006; Gombert-Courvoisier, Sennes, Ricard, & Ribeyre, 2014; Lozano, 2010). Other pedagogical approaches include 'hands-on', 'on-the-job' training (Ferreira et al., 2006), providing decision making tools (Lozano & Lozano, 2014), interdisciplinary approaches (Gombert-Courvoisier et al., 2014; Shrivastava et al., 2013), skills for managing uncertainty, encouraging collaboration (Gombert-Courvoisier et al., 2014) and developmental approaches (Pappas, Pierrakos, & Nagel, 2013).

Table 2.5 Research Themes

Theme & Subthemes	Representative Article(s)	Future Research Questions
Behavioral Change		
Decision Making	(Raivio, 2011)	What variables moderate sustainability decision making?
Discourse	(Paschen & Ison, 2014)	How can discourse analysis inform policy?
Social Norms & Values	(Marcus et al., 2010; Ramaswami et al., 2012; Shrivastava et al., 2013)	What is the process by which individuals learn new values?
Cognitive Frames	(Hahn et al., 2014)	How do cognitive frames vary over time?
Leadership		
Complex Systems Leadership	(Harley, Metcalf, & Irwin, 2014)	Does complexity leadership improve adaptability?
Decentralized Decision Making	(Wong et al., 2011)	How does sustainability performance influence top management teams?
Moral Leadership	(Vinkhuyzen & Karlsson-Vinkhuyzen, 2014)	What are the impacts of leadership training on society?
Consciousness Development	(Boiral et al., 2014)	What conditions foster consciousness development?
	(Harley et al., 2014)	
Leadership Emergence		Use of quantitative methods to validate success in terms of sustainability
Innovation		
Product & Process Innovation	(Gaziulusoy et al., 2013; Jänicke, 2008)	How can undesirable effects of product innovation be anticipated and avoided?
Supply Chain	(Isaksson et al., 2010)	How can systems thinking unlock new opportunities for supply chain innovation?
Sustainable Business Models	(Boons et al., 2013)	What is the role of social-ecological materiality in business model innovation?
Industrial Ecology		
Complexity Theory	(Ashton, 2009; Ehrenfeld, 2007)	What tools can help managers improve both organizational and industrial system sustainability performance?
Eco-Industrial Parks	(Behera et al., 2012; Huo & Chai, 2008)	How can theories of eco-industrial parks account for their dynamic nature to predict and support their growth evolution?

Modular Business Models	(Tsvetkova & Gustafsson, 2012)	How can modularity be applied to reduce system complexity within industrial ecosystems?
Sociotechnical Landscapes	(Allenby, 2009; Ashton, 2009)	How can structures of industrial ecologies maintain flexibility to adapt in a world of rapid technological change?
Social-Ecological Systems		
Collaboration	(Mahoney et al., 2009; Nidumolu et al., 2014)	Identify antecedents of org. resilience that enhance social-ecological resilience
Organizational Climate	(Beermann, 2011; Paschen & Ison, 2014)	What solutions can build short-term and long-term resilience?
Adaptation	(Winn et al., 2011)	What tools can researchers provide managers to build adaptive capacity?
Planetary Boundaries	(Whiteman et al., 2013)	How can understanding social-ecological materiality be used for organizational sustainability strategy setting purposes?
Transitions Management		
Co-evolution	(Loorbach & Wijsman, 2013)	What is the role of business in transitions?
Complex Systems Theory	(Rotmans & Loorbach, 2009)	Provide empirical verification of transitions management frameworks
Policy	(Foxon & Pearson, 2008)	Develop analytical models for policy makers
Spatial Perspectives	(Coenen et al., 2012)	Empirical investigation of spatial scales
Sustainable Consumption and Production	(Mickwitz, Hildén, Seppälä, & Melanen, 2011)	Identify solutions for reduction of resources for consumption and production
Urban Transformations	(Nevens et al., 2013)	Gain understanding of complex city dynamics
Paradigm Shifts		
Educational Shifts	(Ferreira et al., 2006; Manring, 2014)	Determine methods for teaching systems thinking
Management as a Profession & Science	(Bleicher, 1994; Freedman, 1992; Valente, 2010)	What drives the paradigm shift in the management profession?
Societal Shifts	(Seiffert & Loch, 2005; Shin et al., 2008)	Develop integrated knowledge approach to build sustainable societies

Summary of Research Themes

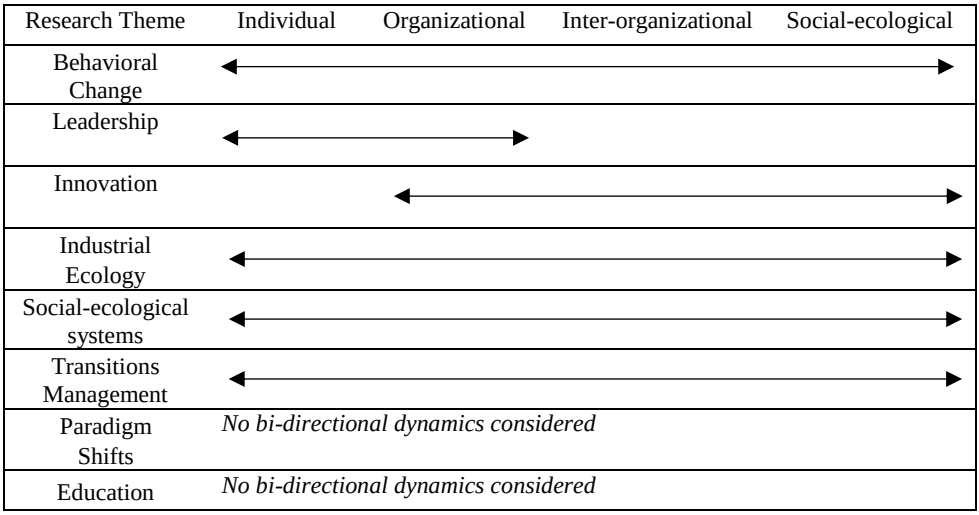
We have presented the research themes separately, however, overlaps in the research themes do exist and two or more research themes can be found in the same article. For instance, the role of *innovation* in social-technical *transitions* is highlighted in the literature (Foxon & Pearson, 2008; Gaziulusoy et al., 2013). Unpredicted technological innovations may lead to changes in policy and shape social-technical systems (Hoppmann et al., 2014). Product *innovations* can have drastic impacts on macro-level consumptions trends in *social-ecological systems* (Vries & Riele, 2006).

Research suggests that *paradigm* shifts are dependent on successful shifts in social systems, in turn creating new opportunities to sustain *social-ecological systems* in the long term (Valente, 2010). *Paradigm* shifts are also dependent on changes in *individual behavior* (Stormer, 2003) and call for changes towards sustainability *education* (Raivio, 2011). The work on *education* highlights the role of sustainability education in preparing future *leaders* in sustainability (Lozano & Lozano, 2014; Lozano et al., 2013). A challenge facing sustainability *education* is preparing *leaders* that can understand the complexities of *social-ecological systems* and the impact of their work (Raivio, 2011; Watson et al., 2013). *Leaders* can take a holistic approach to adapt to *social-ecological systems* and recognize their role as change agents (Metcalf & Benn, 2012, 2013).

Integrated Framework

We developed an integrated framework to give an overview of the research themes presented in the previous section. The contribution of the framework is to demonstrate to what extent each research theme has addressed cross-scale interactions and where gaps still exist. The bidirectional arrows represent conceptual interdependence between the two levels, or that the higher level system influences the lower level system and vice versa. The article per theme that discusses the broadest bidirectional impacts is depicted in Figure 2.3. In this section, we examine the cross-scale interactions found in the literature by each research theme.

Figure 2.3 Integrated Framework



Behavioral Change

We found five articles dedicated to understanding behavioral change. Zhang et al. (2013) test the impact of decision making tools on the strategy of firms in the textile industry, or the impact of individual behavior change on organizational level concepts. Zollo et al. (2013) propose a conceptual framework for understanding change initiatives starting from the individual to organizational level. Their model points to the inter-connections between cross-scale change initiatives and organizational adaptive capacity.

Expanding beyond organizational boundaries, our review also identifies an emerging group of articles using a cognitive framing perspective, that are aimed at understanding how an integrative or paradoxical logic may affect managerial decision making (Gao & Bansal, 2013; Hahn et al., 2015). Hahn et al. (2014) consider the implications of cognitive managerial frames offering that a pragmatic frame may lead to workable solutions and large scale change. Represented in the integrated framework (Figure 2.3), the work on managing tensions in corporate sustainability demonstrates that firms affect and are affected by social-ecological systems and also considers

the tensions between individual and firm level sustainability (Hahn et al., 2015). The systematic framework for managing tensions in corporate sustainability paves the way for future empirical research to consider cross-scale interactions (Hahn et al., 2015: 301).

Leadership

Studies on leadership seek to understand how leaders transform organizations and society. The integrative complexity and decentralization of decision making in top management teams influence corporate social performance (Wong et al., 2011). When understood holistically, leadership initiatives influence company systems such as operations, strategy, and communication and therefore the sustainability dimensions of the firm (Boiral et al., 2014; Lozano & Huisingh, 2011). Leadership that promotes ethical behavior may drive transformational change of sustainable production and consumption systems (Vinkhuyzen & Karlsson-Vinkhuyzen, 2014) and consciousness development may resolve the global economic crisis (Boiral et al., 2014).

As depicted in the integrated framework (Figure 2.3), Painter-Morland (2008) suggests that complex interactions between individuals and groups shapes shared organizational institutions. Sustainability requires leaders to predict complex systems dynamics, quickly adapt and implement organizational change (Metcalf & Benn, 2012, 2013). Factors of community systems may influence which type of leadership emerges and the leader's ability to facilitate sustainable community development (Harley et al., 2014). While this research examines the interdependence between leaders and their organizational environments, research could examine feedback loops with higher level social-ecological systems.

Innovation

Sustainability oriented innovation articles in the review cover all levels of analysis from individual to social-ecological systems. Yet, we did not find a study that explores innovation for adaptive capacity nor research that holistically examines feedback loops at all levels. Most articles identified

sought to understand the implications of firm level innovations (technological, social and organizational) to value chains (Boons & Lüdeke-Freund, 2013) and social-ecological systems (Bocken et al., 2014; Boons et al., 2013; Gaziulusoy et al., 2013), or examined the influence of social-ecological systems on innovations (Luthe et al., 2013; Vries & Riele, 2006). Hoppmann et al. (2014) draw attention to the ongoing dynamics between technological change, social-technical systems and policy, which is represented in the integrated framework (Figure 2.3).

Foxon and Pearson (2008) focus on the social-ecological system level by giving an understanding of the co-evolution of innovation systems of new technology and public sustainability policy systems. We identified two articles that focused on organizational level innovation and implications for the firm (Chang et al., 2014; Gerstlberger et al., 2014). Another two articles examined the connection between inter-organizational networks and organizational innovation (Dougherty & Dunne, 2011; Isaksson et al., 2010). We identified one article that considered individual behavior change. In their study of Irish households, Doyle and Davis (2013) use backcasting of social-technical innovation scenarios including aspects such as regulations, user practices and cultural meanings to stimulate individual self-reflection.

Industrial Ecology

Most articles in the review focusing on industrial ecology connect the organizational level or inter-organizational level to industrial and social-ecological systems (i.e. Batten, 2009; Behera et al., 2012; Cerceau et al., 2014; Romero & Ruiz, 2013; Tsvetkova & Gustafsson, 2012). For example, Despeisse et al. (2012) develop a model for improved environmental performance taking the factory as the unit of analysis and linking manufacturing processes to technical and ecological systems. We identified one paper that is represented in Figure 2.3 (Ramaswami et al., 2012) which conceptually embeds industrial systems in social-ecological systems and considers the role of individual actors. In this study Ramaswami et al. (2012) consider the sustainability of cities in an integrated manner by considering the role of individual actors in social-ecological infrastructural

systems. Industrial ecology scholars have called for research to continue in this integrated direction (Ashton, 2009; Hoffman, 2003; Metson et al., 2012).

Social-ecological Systems

As shown in Figure 2.3, Starik and Rands (1995) and Starik and Kanashiro (2013) provide conceptual foundations for considering dynamic interactions across all scales. We suggest that there is an opportunity to advance this research empirically. Other research explores the role of bottom-up action on systemic change (Gray, 2010; Perey, 2014). Gray (2010) suggests that sustainability of social-ecological systems will be the result of individual, organizational, political, and collective outcomes, but does not explicitly consider the role of feedback loops across scales.

A group of articles considers the adaptation of organizations or individuals to social-ecological systems such as disasters related to climate change (Beermann, 2011; King, 1995; Linnenluecke & Griffiths, 2010; Ortiz-de-Mandojana & Bansal, 2016; Paschen & Ison, 2014; Sterman, 2001; Winn et al., 2011). A second set has considered the feedback relationships, the transformation of social-ecological systems or the role of business in society without attention to the role of individual agency or firm level effects (Kunz et al., 2013a, 2013b; Manring, 2014; Marcus et al., 2010). A third set considers the role of firms in social-ecological systems or as co-evolving with their environment (Hodge, 2014; Porter, 2006; Whiteman et al., 2004, 2013; Winn & Pogutz, 2013). For instance, Winn and Pogutz (2013) offer a theoretical model of organizational ecosystem embeddedness, representing the mutual relationship of impact and dependence between organizations and ecosystems.

Transitions Management

Articles in the transitions management theme have addressed directional change at all scales. However, we found just one model in the review that considers interconnections across all levels. Rotmans and Loorbach (2009) present a holistic transitions management framework for addressing complex social problems (see Figure 2.3). The framework considers

individual learning experiences, mobilization of actors and selection of experiments that can be scaled to drive change.

Other articles have focused on the macro-level. For example, the role of geography in sustainability transitions (Coenen et al., 2012) or the role of business in proactively driving sustainability and public space creation to leverage disruptive change (Radywyl & Biggs, 2013). Another group of articles consider unidirectional change such as the role of political entrepreneurship in driving sustainability transitions (Block & Paredis, 2013). Transitions frameworks are based on multi-level, multi-phase dynamics of change (Geels, 2002). Our review highlights that research does not consistently leverage all levels over time.

Paradigm Shifts

In the paradigm shifts research theme, we find the articles focus on a maximum of two levels of analysis and as represented in the integrated framework, we did not find any cross-scale interactions (Figure 2.3). Most articles focus on how pressures from social-ecological systems can create field level paradigm shifts but the management paradigm has yet to shift from neoclassical and technocentric roots (Seiffert & Loch, 2005; Shin et al., 2008; Stormer, 2003; Valente, 2010). Other articles focus on how individual level management practices are changing as a result of growing complexity in external environments (Freedman, 1992; Lozano, 2008), and how organizations may respond to a sustain-centric paradigm (Gladwin et al., 1995). While Gladwin et al. (1995) suggest that management theory may have encouraged a techno-centric paradigm, our framework highlights that research has ignored the role of change agents in creating cross-scale impacts.

Education

A sustainability oriented transformation of higher education considers different viewpoints from ethical decision making to policy issues (Dlouhá et al., 2013). Three articles consider the unidirectional downward adoption trends of sustainability education (Lozano, 2010; Raivio, 2011; Watson et

al., 2013). Most articles consider the upward unidirectional effectiveness of pedagogical approaches in driving changes towards sustainability in organizations or society (Ferreira et al., 2006; Gombert-Courvoisier et al., 2014; Lozano & Lozano, 2014; Lozano, 2010; Pappas et al., 2013; Shrivastava et al., 2013). In this review, as shown in the integrated framework (Figure 2.3), we did not find any empirical evidence of cross-scale interconnections in the research with regards to sustainability education.

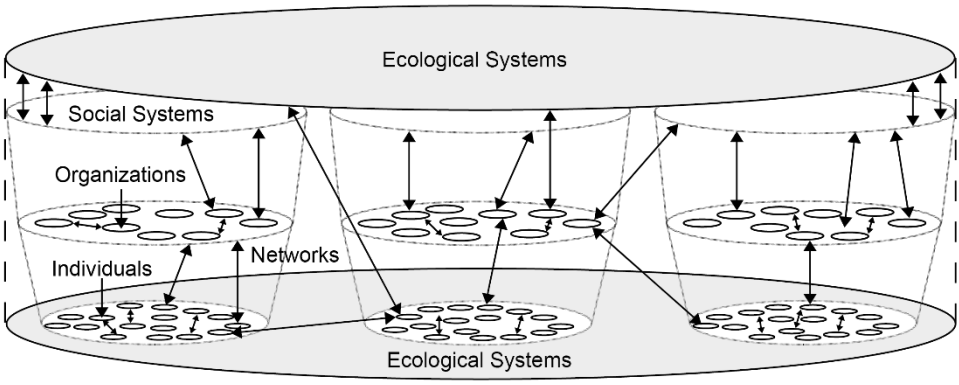
Future Research

Systems thinking is increasingly being used to understand sustainability issues in management but remains peripheral to mainstream organizational journals. We hope that the conceptual foundations identified in this review, such as the emerging field using a paradox lens (Hahn et al., 2015; Van der Byl & Slawinski, 2015) among others, will encourage more scholars in the field of management to understand the complexities of sustainability with systems thinking. Overall, a key implication of our review of systems thinking is for future studies to explicitly recognize social-ecological embeddedness beyond the boundaries of the firm, industry, and product/process level, as well as the interconnections across multi-level, nested social-ecological systems. We conceptualize this in Figure 2.4. In Tables 2.4 and 2.5 we offer specific research questions derived from the representative articles to help guide management scholars and stimulate future research.

For example, the organizational adaptation literature has mainly focused on building organizational resilience in the face of changing climate conditions (Linnenluecke & Griffiths, 2010). This work has already provided new insights into risk management and we encourage future research to consider the impact of other social-ecological systems, such as biodiversity, nitrogen/phosphorus use, and ozone depletion on organizational adaptation strategies (Whiteman et al., 2013). We also invite organizational scholars to move beyond the notion of building organizational resilience

and to consider the implications of building social-ecological resilience (Whiteman et al., 2004; Winn & Pogutz, 2013).

Figure 2.4 Future Research Agenda



Similarly, findings from the innovation research theme show that studies remain focused at the organizational level and on the development of new sustainable processes and products. However, these studies tend to ignore broader systemic feedback loops, and to address specific processes or products in isolation of other developments, both in the technological and ecological spheres. Therefore, future research on sustainability oriented innovation should take a broader scope and examine the implications of developing innovations, including new business models, intended to transform entire systems (Adams et al., 2015).

Another research theme that has been given limited attention by systems thinkers is organizational sustainability reporting. Studies are needed to provide insight into how temporal and spatial interlinkages can be taken into account within organizational sustainability reporting to give a holistic perspective (Lozano, 2013). Integrated reporting has emerged as an innovative topic within sustainability reporting that offers organizations the opportunity to better understand and manage how its business activities affect social-ecological systems. Integrated reporting stimulates 'integrated

thinking' within companies - understanding the relationship between the business model and the capitals it depends on (social, ecological and financial) - in order to identify risks and opportunities in the short, medium and long term. Yet the field of integrated reporting remains nascent and little is known about how it can effectively act as a mechanism for internal organizational change (Perego, Kennedy, & Whiteman, 2016), or how it may effectively improve the resilience of social-ecological systems. We invite scholars to investigate questions such as '*what is driving and inhibiting the diffusion of integrated reporting as a field of management practice?*' and, '*how is integrated reporting reconstructing the ways in which companies, industries, and value chains operate in order to effectively enhance the resilience of social-ecological systems?*'

We were surprised to find that systems thinking has yet to be fully leveraged as a frame for understanding collaboration for sustainability, although collaboration is acknowledged to be important for achieving sustainability goals (Lozano, 2008). Clarke and Fuller (2010) found that stages of collaborative strategic management are driven by feedback loops and adaptation to feedback loops drives emergent strategies. Future research questions could address, '*does collaborative action help to understand complex interactions between social-ecological systems?*' and '*how can systems thinking be used to understand multi-stakeholder platforms driving action across scales?*"

Finally, we suggest that a further integration between research themes is needed to advance the field of sustainability management. For instance, our review highlights that industrial ecology gives much insight on how to build production systems while minimizing environmental impact. If connected with the work on social-ecological systems (Whiteman et al., 2013), we would have a better understanding of what is needed to achieve global sustainability within the limits of the planet (Rockström, Steffen, Noone, Å. Persson, et al., 2009).

Conclusion

In 1995, Gladwin et al. called on management scholars to develop theories that reintegrate organizations with the social and ecological systems in which they are embedded. In the same early special issue on sustainability management, Starik and Rands (1995) invited studies that explore the linkages between organizations and all system levels and give insight into the strategies that may lead to overall systemic sustainability.

Our review indicates that many organizational scholars have endeavored to take up this challenge, applying core concepts of systems thinking in sustainability management research and advancing understanding through a number of research themes. Our results illustrate the exponential increase in publications on systemic dimensions to sustainability management, with the *Journal of Cleaner Production* clearly in a leadership position as the primary publication outlet for systems thinkers. We also observe that extant research is largely fragmented and marginal to the mainstream management journals.

Furthermore, the results of our review illustrate the field could benefit from more transdisciplinary research in order to better understand sustainability from a holistic systems perspective. Considering the interconnectedness of social-ecological systems and determining meaningful transition pathways requires multi-disciplinary work based on systems thinking originating in both management studies and ecology (Starik & Rands, 1995; Whiteman et al., 2013).

Our study has the following main limitations. First, the review is constrained by its selected time period excluding any early contributions to the field (pre-1990) and through its selection of academic journals. Future reviews may find manageable ways to broaden their searches to capture contributions from books, conference papers, articles written in languages other than English and literature from sources other than journals should be given consideration. Second, our process of article identification through a keyword-based search and academic expert review may not have captured all relevant contributions to the field. Third, only the database SSCI was used for the review. Future reviews may consider the dual use of databases

to give greater reliability to the results. Finally, our review is focused mainly on peer reviewed journal articles. This may exclude useful contributions from other sources such as book chapters that often give space for new ideas and perspectives to form.

Despite these limitations, we believe that this review draws greater attention to the potential of systems thinking and encourages other management journals to expand their integration of such ideas. In order to facilitate the uptake of systems thinking, we also provide guidance on future research questions. In the words of recognized systems thinker and leader of corporate sustainability, Paul Polman, CEO of Unilever, "I truly believe that future leaders will be systems thinkers. It is inconceivable that anyone will successfully steer companies, or countries, through our volatile world without understanding the interdependencies between the systems on which we depend" (Polman, 2014a).

CHAPTER 3 CROSS-SCALE SYSTEMIC RESILIENCE: IMPLICATIONS FOR ORGANIZATION STUDIES[2]

Abstract

In this article, we posit that a cross-scale perspective is valuable for studies of organizational resilience. Existing research in our field primarily focuses on the resilience of organizations, i.e. the factors that enhance or detract from an organization's viability in the face of threat. While this organization level focus makes important contributions to theory, organizational resilience is also intrinsically dependent upon the resilience of broader social-ecological systems in which the firm is embedded. Moreover, long-term organizational resilience cannot be well managed without an understanding of the feedback effects across nested systems. For instance, a narrow focus on optimizing organizational resilience from one firm's perspective may come at the expense of social-ecological functioning and ultimately undermine managers' efforts at long term organizational survival. We suggest that insights from natural science may help organizational scholars to examine cross-scale resilience and conceptualize organizational actions within and across temporal and spatial dynamics.

[2] Williams, A., Whiteman, G. & Kennedy, S. First Round Revisions.

We develop propositions taking a complex adaptive systems perspective to identify issues related to focal scale, slow variables and feedbacks, and diversity and redundancy. We illustrate our theoretical argument using an example of Unilever and palm oil production in Borneo.

Introduction

In 2014, Paul Polman, CEO of Unilever said "It is inconceivable that anyone will successfully steer companies, or countries, through our volatile world without understanding the interdependencies between the systems on which we depend" (2014a). This is easier said than done. A recent review of the systems literature in management studies shows there are very few case studies that describe the complex dynamics of managing for organizational resilience across nested social-ecological systems (A. Williams et al., 2017). A nested social-ecological system is an "integrated system of ecosystems and human society with reciprocal feedbacks and interdependence" (Folke et al., 2010: 20). In contrast, the field of natural science has developed a large body of literature on managing resilience across nested social-ecological systems (Biggs et al., 2012a; Biggs, Schlüter, & Schoon, 2015; Walker et al., 2006). Key to this work has been the recognition that constellations of organizations and ecosystems co-evolve through the collective adaptive capacity of actors (including humans and ecological species) who identify and respond to interdependencies between and within social and ecological systems at the planetary, regional, and local scales over time. Resilience thinking from a systems perspective necessitates the management of complex systems across scales.

Furthermore, social-ecological resilience is the buffering capacity of a system to cope with change and unforeseen disturbances while safeguarding the ecological systems on which human activity depends (Berkes & Folke, 1998; Folke et al., 2016). The resilience of a social-ecological system is determined by the capacity of the actors in the system to learn from experience, gather knowledge and respond to changing conditions, or in other words, its adaptive capacity (Folke et al., 2010). Patterns of low and

high resilience in social-ecological systems are described by the adaptive cycle, developed by globally recognized scientists Buzz Holling and Lance Gunderson (2002). The adaptive cycle proposes that systems cycle through four phases: growth, conversation, release and renewal. As systems pass from growth to conversation the resilience of the system shrinks because it becomes brittle and fragile (Holling, 2001). Then, resilience increases as the system renews allowing for experimentation and novelty (Holling, 2001). Adaptive cycles are nested, "within each other across space and time scales" (Holling, 2001: 396).

While resilience thinking is not new to organizational scholars (Weick & Roberts, 1993), the dominant focus has been on building organizational resilience to external threats (Linnenluecke, 2015; Weick, 1993), or on enhancing intra-organizational reliability (Weick & Roberts, 1993). A more holistic and dynamic understanding of multi-level resilience across social, ecological, and organizational remains underdeveloped (Linnenluecke, 2015; T. A. Williams, Gruber, Sutcliffe, Shepherd, & Zhao, 2017). In this paper, we connect knowledge on social-ecological resilience from natural science to what we know about organizational resilience and present propositions for future research that are multi-level and systemic. More specifically, we assess how natural science insights on nested adaptive cycles can help organization scholars better understand the interactions and vulnerabilities inherent in the complex nested systems of humans and nature (King, 1995).

To date, only a few studies incorporate the concept of adaptive cycles within organization studies. These have focused on firm or community level dynamics such as organizational change in response to extreme weather events (Linnenluecke & Griffiths, 2010), external conditions (Yang, Bansal, & DesJardine, 2014) ecological adversity (Clément & Rivera, 2016), and ecosystem dynamics (King, 1995). While valuable for understanding certain aspects of organizational vulnerability, these studies do not consider how adaptive cycles are nested over spatial and temporal scales beyond organizational boundaries. We address this gap in the literature by

developing a cross-scale perspective of resilience for organization studies drawing upon the natural sciences.

We advance organizational theory on resilience in two ways. First, we aim to bridge the literature on organizational and social-ecological resilience. Research in organization studies focuses on how to build organizational resilience to external threats (Linnenluecke, 2015; A. Williams et al., 2017; T. A. Williams et al., 2017), and can benefit from conceptual developments from outside the field that seek to understand complex dynamics of social-ecological systems to build cross-scale resilience (Biggs et al., 2012a, 2015). In this article, we suggest that insights from the natural sciences—specifically nested adaptive cycles—can help us bridge these two fields of inquiry.

Second, we develop propositions for future research encouraging an understanding of resilience for organizational studies across spatial and temporal scales. We suggest that focal scale, slow variables, and diversity and redundancy are important factors underlying managerial approaches to managing cross-scale resilience. Following each proposition, we illustrate our theoretical argument with a vignette of Unilever and Borneo (Whiteman et al., 2013).

Our paper is organized as follows. First, we introduce the theory of cross-scale resilience from the natural sciences and then discuss four articles in organization studies that have applied the adaptive cycle. Second, we develop propositions for a cross-scale perspective of organizational resilience and at the same time we illustrate our argument with an example of Borneo and Unilever, based on secondary documents. Finally, we discuss how the advances we make differ from the existing literature and can provide valuable insights for organizational resilience.

Nested Cross-Scale Resilience in Natural Sciences

The natural sciences adopt a complex adaptive systems approach to resilience to understand social-ecological dynamics and integrate underlying assumptions of time and space. When resilience theory in the

natural sciences was initially formulated in the 1980s (Holling, 1986) it "stood in stark contrast to previous ecological theories which tried to understand steady state dynamics" (Whiteman et al., 2013: 6). In this paper, we consider how insights on social-ecological resilience from the natural sciences have important theoretical implications for organization studies and demand attention to form a more complete understanding of resilience.

Social-ecological systems are conceptualized as a nested set of adaptive cycles over spatial scales. By the term system, we refer to "a set of elements or parts that is coherently organized and interconnected in a pattern or structure that produces a characteristic set of behaviors, often classified as its 'function' or 'purpose'" (Meadows, 2009: 188). In this paper, we refer to nested systems and the interactions between organizational, economic, societal and environmental systems. Higher-level systems are large in size and change slowly, while lower level systems are small and change quickly. Changes in the adaptive cycle at one level can potentially cascade across systems, influencing the adaptive cycle at other levels and the combined dynamics of the entire set of systems (Gunderson & Holling, 2002). We build on knowledge from the natural sciences and suggest that cross-scale interactions between systems may have important consequences for organizational resilience and demand greater attention in order to gain a more complete understanding of managing for resilience.

System resilience is not a fixed concept, but instead expands and contracts over time (Gunderson & Holling, 2002). When a system's components become increasingly connected they become more stable, but also more rigid as dependency upon existing structures and processes increases. Rigidity may result in a loss of resilience and an increase in vulnerability to external and internal shocks. For instance, when a firm reduces its product offerings in pursuit of efficiency, the firm will become increasingly vulnerable to any disruptions in the supply chain of those products. Conversely, when a system's components become more loosely connected, they become more flexible, permitting experimentation and new combinations of components. For example, following a climate related

disaster a firm may recover from the disaster and experiment with new ways to respond to future climate related disasters.

The patterns by which resilience expands and contracts are explained by the adaptive cycle (Holling, 1986). The adaptive cycle challenges stable equilibrium views of the world by emphasizing rapid change and non-linearity (Folke, 2006). In the front loop of the adaptive cycle, systems grow until maturity and systems dynamics are relatively stable (Gunderson & Holling, 2002). The front loop is characterized by a transition from exploitation of resources to conservation. In the back loop of the adaptive cycle, a disturbance, shock or disaster pushes the system into a phase of creative destruction before reorganizing (Gunderson & Holling, 2002). Periods of stability and instability are not always predictable and systems do not always progress sequentially from exploitation and conservation and then to release and reorganization (Walker, Holling, Carpenter, & Kinzig, 2004). The emergent dynamics may cause systems to remain in one phase for longer or initiate regression back to a previous phase. In Table 3.1, we summarize the adaptive cycle and identify the triggering mechanisms which incite change and a shift to another phase.

Table 3.1 The Adaptive Cycle

Phase	**Front loop** Exploitation to conservation	**Back loop** Release to reorganization
Description	A long period of slow growth of resources characterized by: Stability, increasing resilience, connectivity, rigidity, and vulnerability, incremental innovation	A shorter period of rapid change and innovation characterized by: Instability, low connectedness, variety, low predictability, high uncertainty, radical innovation
Mechanisms triggering the next phase	Social-ecological triggers: Crises, shocks, shifting societal values Individual triggers: Capturing opportunities, internal crisis	Social-ecological triggers: Diffusion, engaging stakeholders Individual triggers: Leadership, reframing, experimentation
Conditions prolonging the phase	Social-ecological conditions: Institutionalization, high resilience, lock-in, lack of novelty Individual barriers: lack of effective leadership	Social-ecological conditions: Lack of resources or novelty Individual conditions: Inaction

Natural sciences also acknowledge that changes to the resilience of a system do not "take place in a vacuum" and cross-scale interactions influence the dynamics of complex systems (Folke et al., 2016: 40; Gunderson & Holling, 2002). Adaptive cycles are interconnected and nested without implying top-down control (Simon, 1974). Higher-level systems are large in size and change slowly, while lower level systems are small and change quickly. The pace of change in nested adaptive systems is relative to each specific case. Changes to the adaptive cycle of one system will interact with other connected adaptive cycles and have consequences for their functioning and resilience.

A focal system is directly connected to the systems one level below and one level above it (Walker & Salt, 2006), but impact is also possible across all scales, bottom-up or top-down. Change in systems can cascade up and impact the dynamics of higher level systems: known as a *revolt* force. During the creative destruction phase (release) of an adaptive cycle, the effects of the collapse and change can cascade up. These effects will be larger if the higher-level systems are not resilient to the disturbance. For example, influential individual leaders can implement firm-level sustainability strategies that drive organizational change, and this may cascade further to higher levels in which the organization is embedded such as industry levels. Higher level systems may also influence the dynamics of lower level systems: known as a *remember* force. In the reorganization phase of the adaptive cycle, knowledge from previous experiences emerge and determine the attributes of the new system. Higher-level systems may act to constrain the potential, and opportunities, for renewal of lower-level systems. For example, highly institutionalized practices within an industry or the memory of existing processes and structures may prevent organizational change (Allen, Angeler, Garmestani, & Gunderson, 2014). An example of the remember force occurs when the company's operations are disturbed by a climate related disaster. The disaster may shift the company from the front loop into the back loop of the adaptive cycle.

Organization Studies and Resilience

Organization scholars have explored issues such as organizational resilience to external threats (Weick, 1993), intra-organizational reliability (Weick & Roberts, 1993), employee strengths as sources of resilience (Luthans, 2002), and the role of institutional work in developing social capital and enabling resilient institutions (Barin Cruz, Aguilar Delgado, Leca, & Gond, 2016). Research has found that managers may build organizational resilience through approaches such as sensemaking and monitoring (Weick, 1993; Whiteman & Cooper, 2011), learning from previous experiences (Berkes & Folke, 2002) and building diversity, redundancy, modularity and short information feedbacks (Folke et al., 2016). Yet, while organizational resilience continues to garner increased scholarly attention, only a subset of scholars have sought to go beyond a firm-level or supply chain interpretation of resilience to consider potentially important cross-scale interactions (Linnenluecke, 2015; A. Williams et al., 2017; T. A. Williams et al., 2017).

Cross-scale interactions may be considered along two dimensions of temporal and spatial scales. Studies focusing on temporal aspects have shown that firm-level sustainability practices contribute to the long-term resilience of the organization (DesJardine, Bansal, & Yang, 2017; Ortiz-de-Mandojana & Bansal, 2016). This research suggests that a focus on short-term profits may harm organizational resilience (Ortiz-de-Mandojana & Bansal, 2016). Research focusing on spatial scales illustrates how organizations can contribute to the resilience of broader social systems such as communities or cities (Barin Cruz et al., 2016; McKnight & Linnenluecke, 2016). Organizations have both a dependence on ecosystem functions and an important impact on their provisioning (Clément & Rivera, 2016; Whiteman et al., 2004; A. Williams et al., 2017; Winn & Pogutz, 2013).

At present, four articles explicitly apply the adaptive cycle from Gunderson and Holling. The adaptive cycle (Gunderson & Holling, 2002) was introduced to the organizational literature by King (1995) in an article that conceptualized ecosystem dynamics and based on insights from historical analysis suggested how to manage natural resources to avoid an

ecological surprise. More recently organizational scholars have drawn on the adaptive cycle to explain organizational resilience to extreme weather events (Linnenluecke & Griffiths, 2010), ecological adversity (Clément & Rivera, 2016) and external conditions (Yang et al., 2014). We provide more detail below.

Yang et al., (2014) considered how nested adaptive cycles could apply to individuals or groups of individuals, within organizations. This work suggested that organizational subsystems have their own adaptive cycles and interact with one another across scales (Yang et al., 2014). The authors proposed that managers may consider functional redundancy and cross-scale variation of nested adaptive cycles as ways to contribute to organizational resilience (Yang et al., 2014). Surprisingly, this study ignored the social-ecological roots of the concept of the adaptive cycle, and did not extend its theorizing beyond the firm to analyze the firm's embeddedness within social-ecological systems and dependency on ecosystem resilience.

Linnenluecke and Griffiths (2010) used the adaptive cycle as a useful metaphor for "organizational exposure to impacts from climate change and extreme weather events" (p. 492). This conceptual study used the four stages of the adaptive cycle to build an organizational resilience framework that showed how firms may absorb impacts caused by extreme weather events and maintain their structure and function. Specifically, the framework outlined how extreme weather events pushed organizations into the release phase from which they begin to recover as long as the threshold beyond which an organization loses functioning and control was not crossed. However, although Linnenluecke and Griffiths (2010) acknowledged the concept of nested adaptive cycles and the importance of cross-scale interactions, they do not attempt to build this into the resilience framework.

Clément and Rivera (2016) extended this work by considering organizational resilience to the impact of ecological adversity more broadly. Ecological adversity may be sudden, but may also be characterized as gradual changes that persist at all stages of a firm's adaptive cycle, which

managers continually need to adapt to in order to maintain organizational resilience. However, under high levels of ecological adversity, organizations may reach adaptation limits and undergo transformations that fundamentally alter the way in which they operate. Transformations may occur reactively in response to a shock in the release phase of the adaptive cycle, or proactively to intentionally push the organization into the release phase and avoid reaching adaptation limits (Clément & Rivera, 2016).

Clément and Rivera (2016) also propose that when faced with ecological adversity, firms may pursue adaptation strategies that are deleterious to ecosystem resilience. For instance, a firm may attempt to secure the continued supply of a depleting natural resource and use this resource beyond rates of regeneration. In turn, this feeds back to further constrain the adaptation of firms to the ecological adversity and diminishes their organizational resilience. For example, continued resource use degrades the ecosystem's resilience and it is no longer able to recover from shocks to provide the resources necessary for firm operations. While this reasoning suggests interdependencies between organizational and ecosystem resilience, we argue that it demands a more in-depth analysis of cross-scale interactions, which consider temporality (i.e. resilience over time) and embeddedness (i.e. cross-scale spatial interconnections between organizational and social-ecological resilience).

Finally, the early research of King (1995) linked organization theory to ecosystem dynamics by integrating lessons from long standing traditional communities. The article showed that human interference with the adaptive cycles of natural ecosystems can fundamentally change the behavior of a system. For instance, when managers optimize one variable of the system, such as maximizing the growth of one productive tree species, the ecosystem will become more vulnerable to shocks and disturbances such as disease that may cause the ecosystem to collapse. This work provided valuable insights from traditional communities on managing ecosystems and raised questions about the applicability of the lessons for modern organizing. We argue that subsequent work focused on identifying factors which contribute to organizational resilience in response to organizational

disturbances, rather than identifying elements of ecosystem management to avoid disturbances (King, 1995).

These studies together form a solid conceptual ground for us to further consider the time and space of organizational resilience in the face of dynamic social-ecological systems. In particular, we attempt to build upon King's (1995) work on local communities by considering an illustrative example of a multinational corporation with global supply chains. Linking business-level processes to macro-level ecological process situates firms (and industries) within broader social-ecological systems and helps them to understand the ongoing threats at the planetary level (Whiteman et al., 2013). Companies need to measure their impact on, and feedbacks from, social-ecological systems that are approaching or that have already exceeded the safe threshold to support human life (Whiteman et al., 2013). The importance of building such cross-scale resilience for managers is easily visible in industries that are highly dependent on ecosystem services, such as fishing, forestry, tourism and agriculture (Clément & Rivera, 2016; Whiteman & Cooper, 2000). Yet, due to the complexity of temporal and spatial scales underlying potential issues, managers may fail to notice important issues (Bansal et al., 2018). King (1995) posits that managers can avoid ecological surprises by rapidly perceiving and internalizing information about ecological change, increasing the visibility of change, creating channels to transfer knowledge quickly, and encouraging flexibility and diversity in resources.

A nested systems analysis of resilience is critical due to linkages and interdependencies that mean that actions on one scale influence the system behavior and resilience of systems across scales. Managing for sustainability without appreciation of the cross-scale dynamics may neglect vital information on how higher and lower order systems may respond to firms' actions. This may lead to firms unwittingly pursuing the goals of a subsystem at the expense of the total system (Meadows, 2009) and to cross over critical ecosystem boundaries that define the safe operating space for humanity (Rockström, Steffen, Noone, A. Persson, et al., 2009). As such, we seek to extend the existing body of work by offering a nested systems

analysis of organizational resilience, thus paving the way for future research to consider cross-scale resilience.

A Systemic Framework for Managing Cross-Scale Resilience

In this section, we take a deeper dive into the literature on nested adaptive cycles from the natural sciences and propose implications for organizational resilience theory. The concept of nested adaptive cycles emphasizes how cross-scale interactions drive change in interconnected systems (Gunderson & Holling, 2002) and takes into consideration the dynamic behavior of interconnected systems of humans and nature over time (Walker & Salt, 2006). We also develop a series of propositions for future research that examine resilience across temporal scales and nested systems. Following each proposition, we illustrate our argument with an example of Unilever and Borneo. To do this, we draw on secondary documents published in academic journals, NGO and industry reports, Unilever's website and reports, and news articles.

Illustrative Example: Background

Unilever is an Anglo-Dutch multinational company in fast moving consumer goods. In 2017, Unilever's annual revenue was in excess of €50 billion, it employed 161,000 people, and held around 400 brands across four categories of personal care, refreshment, food and home care (Unilever, 2018a). Many of these brands contain palm oil, such as products in spreads and cooking oils, deodorants, laundry detergents, shower gels and shampoos, and skin care. Akin to its competitors, Unilever sources much of its palm oil from Borneo, with 95% of its known crude palm oil mills located in either Indonesia or Malaysia (Unilever, 2014a). In our illustration, we consider how Unilever might build resilience across scales to manage not only organizational resilience but also the resilience of the social and ecological systems that the company depends on in Borneo.

We also suggest that cross-scale resilience cannot be enhanced through a siloed approach which focuses on building organizational resilience in

response to extreme weather events, in isolation from the vulnerabilities palm oil production places on the global climate system. By pursuing organizational resilience without fully appreciating cross-scale interactions, Unilever is at risk of neglecting important dynamics and causing unforeseen adverse consequences for ecosystem resilience. That is, the ecosystems of Borneo are responding to adversity in complex ways, which may not be recognized or anticipated in more linear organizational responses to the adversity.

Complex Adaptive Systems and Focal Scale

One explanation why organizational researchers have yet to address issues of cross-scale resilience is a focal scale bias. Many studies (and managers) take a firm-centric supply chain approach to organizational resilience. For example, existing organization studies account for both mitigation and adaptation strategies to build organizational resilience to the effects of climate change (Linnenluecke, Griffiths, & Winn, 2013; Winn et al., 2011). To prevent disasters from occurring, mitigation strategies include reducing environmental impacts and corporate greening (Winn et al., 2011). When impacted by adversity, organizational responses are implemented to restore performance (Linnenluecke & Griffiths, 2010). In this sense, indicators of adaptive capacity to maintain organizational resilience include the firm's rate of recovery and the maximum impact tolerable (Linnenluecke & Griffiths, 2010). However, the literature has yet to consider corporate efforts to restore ecosystem services across different, yet interconnected geographies (Pogutz & Winn, 2016; Winn & Pogutz, 2013), thereby enhancing cross-scale resilience. Due to this focal scale bias, pressing issues inherent in complex social-ecological dynamics may go unnoticed and the resilience of the systems that organizations depend on continue to decline.

In contrast, a review of the literature on enhancing ecosystem resilience finds that an understanding of social-ecological systems as complex adaptive systems fosters appropriate actions and decision making for managing ecosystem resilience (Biggs et al., 2012a). While a complex adaptive systems view does not directly influence resilience, empirical

studies in conservation have shown that it does influence managerial cognition during the process of noticing and responding to ecological cues: "abundant empirical evidence of conventional resource management practices that optimize provision of a narrow set of [ecosystem services] on the basis of linear, reductionist mental models of ecosystems, which inadvertently undermine the ability of these systems to continue producing [ecosystem services] in the face of disturbance and change" (Biggs et al., 2012a: 432; Holling & Meffe, 1996). Likewise here, we suggest that studies of organizational resilience too narrowly define the focal scale to the firm and/or supply chain level; thereby, missing important cues in other focal scales and ecosystems and leading to an overall reduction in resilience (Whiteman & Cooper, 2011).

A complex adaptive systems view emphasizes holism and understanding how individual components of a system give rise to the overall system dynamics, as opposed to reductionism and understanding individual system components in isolation from the larger system (Biggs et al., 2012a). Since, systems are nested across temporal and spatial scales, and changes at one scale can potentially influence the entire system, managing resilience by focusing on one system in isolation from the rest is incomplete (Walker & Salt, 2006). Due to possibility for shocks to cascade across nested adaptive cycles, feedbacks due to declining social-ecological resilience are not necessarily felt in the same spatial scale where the disruption that degrades resilience occurs. While much of the organizational resilience literature focuses on organizational responses to environmental threats, the focal scale is centered on the feedbacks felt by organizations, rather than on the cause of the feedbacks driven by declining social-ecological resilience at another spatial scale. Therefore, due to a spatial scale bias, organizations are building resilience to the effects of the problem, rather than addressing it at the core.

However, research in conservation management suggests that by appreciating the properties of complex adaptive systems provides benefits to the management of ecosystem resilience. Furthermore, "Examples of transformations in ecosystem management suggest that changes in

underlying mental models that acknowledge that characteristics of [social-ecological systems] as [complex adaptive systems] can lead to improvements in the resilience of [ecosystem services]" (Biggs et al., 2012a: 432). Extending this into organizational studies, we propose:

> Proposition 1a: When managerial approaches suffer from a focal scale bias (and narrowly interpret resilience as an organizational variable), important cues from other spatial scales are overlooked, leading to a decline in cross-scale resilience

> Proposition 1b: Managerial approaches that interpret social-ecological issues based on properties of complex adaptive systems (multi-scale, nested feedbacks) enhance cross-scale resilience

We now turn to our illustrative example and discuss how a spatial scale bias, i.e. focusing on the effects of climate change at a different spatial scale, leads to declining social-ecological resilience in Borneo. In 2015, Unilever CEO Paul Polman stated, "We are seeing the effect of climate change in our own business. Shipping routes cancelled because of hurricanes in the Philippines. Factories closing because of extreme cold weather in the United States. Distribution networks in disarray because of floods in the UK. Reduced productivity on our tea plantations in Kenya because of weather changes linked to deforestation of the Mau forest. We estimate that geo-political and climate related factors cost Unilever currently up to €300 million a year" (Polman, 2015).

Paul Polman's reflections demonstrates that the company is aware of the consequences of deforestation and the feedbacks felt on Unilever's supply chain. Unilever and its supply chain are in turn directly affected by climate change, representing the remember connection in nested adaptive cycles from the planetary to the firm level. Supply chain disruptions and reduced productivity through water scarcity and adverse growing conditions have caused significant increases in costs to its global

operations. Climate related instabilities and disturbances have directly impacted the resilience of Unilever.

Tackling climate change and its consequences is a core component to Unilever's Sustainable Living Plan (SLP), which seeks to decouple the company's economic growth from its environmental footprint. Under the SLP, Unilever set an ambitious target to halve its greenhouse gas emissions associated with production and consumption by 2030. In pursuit of this strategy, the firm has taken steps to reduce the carbon footprint of its operations. For instance, products have been redesigned to enable reduced consumer usage such as concentrated laundry detergents, packaging has been reduced such as for compressed deodorants, and new low-carbon products have been developed such as dry shampoos (Unilever, 2018b).

Furthermore, the SLP seeks to reduce greenhouse gases and managing natural capital is addressing the environmental degradation caused by palm oil, a primary raw material used in many of its products. Unilever has committed to achieving zero net deforestation by 2020 and states that it is: "determined to work with the palm oil industry to drive deforestation out of its supply chain" (Unilever, 2014a: 3).

The company's SLP also aims to improve health and wellbeing of more than one billion people. To do so, Unilever leverages its resources and networks to prepare for natural disasters and the increasingly more frequent effects of climate change (Unilever, 2018c). Unilever helps their businesses, companies in their supply chain and communities to prepare for disasters and ensure business continuity (Unilever, 2018d). After disaster strikes, the company provides emergency relief by contributing expertise, products and financial support.

Much of this work, reduction of greenhouse gases (mitigation) and disaster preparedness (adaptation), can be seen to improve Unilever's organizational resilience, its ability to achieve preferable outcomes despite adversity from climate induced extreme weather events (Sutcliffe & Vogus, 2003) and to reduce its environmental impact. While Unilever is working to reduce greenhouse gas emissions, halt deforestation and prepare for climate related disasters (in other words, it is building its organizational

resilience to cope with adversity), the ecosystem resilience of one of its major sources of supply, Borneo, continues to decline. Unilever's 'climate proofing' strategy to mitigate against the growing costs of climate change has yet to effectively address social-ecological vulnerability in Borneo. Unilever's strategy to halt deforestation can prevent further increases in greenhouse gas emissions. However, a preventative strategy focusing on supply chain resilience to climate related extreme weather events and environmental impact reductions are unlikely to restore ecosystem resilience.

A cross-scale understanding of organizational resilience may prevent unintended consequences such as the transfer of ecological impact from one natural system to another that may result from a narrower view (Shrivastava, 1995c). In addition, it may prevent optimization of the resilience in one system at the expense of resilience in another system (Carpenter, Walker, Anderies, & Abel, 2001). For example, in the illustration of Unilever, by focusing on responding to the effects of climate related natural disasters rather than building the resilience of social-ecological systems, the company could potentially optimize organizational resilience at the expense of the resilience of the ecosystems the company depends on.

Managing for Slow Variables and Feedbacks

Some studies of organizational resilience have examined firm responses to external threats from the natural environment, and changes to fast changing variables such as weather patterns (Linnenluecke et al., 2013; Winn et al., 2011). While some of these studies overlook the interactions and feedbacks between variables operating at varying speeds that determine the structure of social-ecological systems (Walker & Salt, 2006), others have identified the need for managers to pay attention over longer time period to ecological cues from slow moving variables such as climate (Whiteman & Cooper, 2011). Ecosystem functioning and resilience cycles are related to both fast and slow moving variables, such as level of rainfall, insect populations or amount of soil organic matter, climate, atmospheric gases and fresh water (among others) which collectively determine socio-ecological system

behavior and critical changes (Walker et al., 2006; Walker & Salt, 2006). Ecosystem regime shifts occur due to changes in slow variables in combination with a disruption to the adaptive cycle that pushes social-ecological systems over a threshold point (Biggs et al., 2012a). Managing for cross-scale resilience requires the identification of the slow variables that govern the behavior of specific social-ecological systems and if thresholds are in danger of being exceeded (Walker & Salt, 2006).

Time delays are a key factor in efforts to manage and respond to changes driven by slow variables (Meadows, 2009). For instance, research suggests that the indicators of a potentially consequential change in ecosystems may occur too late for management to avert the shift (Biggs, Carpenter, & Brock, 2009). Due to system inertia, there is a time delay between recognizing an impending threshold and society's response to the warning signals (Steffen, Richardson, et al., 2015). Managers experience perception delays in identifying changes to the behavior of social-ecological systems (Meadows, 2009). Managerial efforts to build cross-scale resilience seek prompt discovery and use of information relating to the *pace of change* within ecosystems and the global, regional and local *thresholds of social-ecological systems*. By acting early, a firm is in a better position to avoid ecosystems crossing tipping points and activating ecological feedback loops (Whiteman & Cooper, 2011). Therefore, we propose:

Proposition 2a: When managerial approaches do not identify slow variables and monitor their changes with respect to threshold limits, important ecological cues are overlooked, leading to a decline in cross-scale resilience

Proposition 2b: Managerial approaches that identify and monitor slow variables across ecosystems in which they operate will enhance cross-scale resilience

In our example it took Unilever many years to fully acknowledge changes to the functioning of the Bornean ecosystem and the wider consequences of

these changes. Preserving social-ecological resilience would require recognizing an impending threshold with a sufficient time-lag to respond to the threshold and avert the consequences. To this end, a planetary boundary of both land use change and biodiversity loss in Borneo negatively affect an important buffer between the predicted safe operating space and crossing a biophysical threshold (Rockström, Steffen, Noone, A. Persson, et al., 2009; Steffen, Richardson, et al., 2015). Because of the importance of the Borneo ecosystems to the global climate system, managerial attention to slow moving variables such as climate and biodiversity loss are important aspects of cross-scale resilience. For example, climate change and land use change both created vulnerabilities in Borneo which made it susceptible to widespread wildfires—e.g., natural scientists estimate that in 1997 such fires released carbon "equivalent to 13–40% of the mean annual global carbon emissions from fossil fuels" (Page et al., 2002; Rockström, Steffen, Noone, Å. Persson, et al., 2009: 15 Appendix 1).

Secondly, there are delays in organizational responses as firms make only partial adjustments until the trends of reduced resilience become increasingly evident. Time delays such as these can be caused by the lack of appropriate information flows or geographically dispersed operating structures. Our Bornean example illustrates that firms may make slow and measured changes to their supply chain toward reducing deforestation. According to natural science studies, "A globalized world of human actions tipped the interplay between climate events and biodiversity into an undesirable dynamics and created vulnerable landscapes of Borneo" (Rockström, Steffen, Noone, Å. Persson, et al., 2009: 15 Appendix 1).

By better understanding slow variables and feedbacks to the adaptive cycle of the Bornean ecosystems, Unilever would be able to identify if and why the ecosystem may be advancing in its front loop towards becoming vulnerable to collapse. Identifying thresholds would enable Unilever to understand when global, regional and local ecosystem may enter into alternate regimes (Walker & Salt, 2006) that may be unfavorable. Unilever would seek to identify the points at which the ecosystems could no longer

recover to the same functioning by considering variables such as the minimum level of forest cover.

Managing Diversity and Redundancy

Slack resources, diversity and redundancy, absorb the shocks of adversity and build resilient supply chains (Linnenluecke, 2015). However, it is less clear how failure to monitor diversity and redundancy beyond the supply chain level influences cross-scale resilience. Research suggests that diversity and redundancy influence the resilience of ecological systems as the backbone of ecological functioning (Elmqvist et al., 2003; Rosenfeld, 2002; Walker et al., 2006). Diversity of different forms "variety (how many different elements), balance (how many of each element), and disparity (how different the elements are from one another)" influences the resilience of social and ecological systems (Biggs et al., 2012a: 425). Redundancy is "a system property that describes the replication of particular elements or pathways in a system" (Biggs et al., 2012a: 425).

Response diversity and functional redundancy are useful system components in response to disturbances to the adaptive cycle (Biggs et al., 2012a; Walker et al., 2006). Response diversity is the number of alternative ways in which the system is capable of responding to a disturbance. Functional redundancy is the ability of different system elements to perform substitute functions (Biggs et al., 2012a). Response diversity enables ecosystems to persist in their functioning when suffering a shock because the variability in species responses maintains the ecosystems capacity for renewal and reorganization (Elmqvist et al., 2003). Functional redundancy reduces the impact of disruptions on ecosystem functioning when events such as disease or habitat loss cause select species to decline, there are other species available to fulfill the same roles (Rosenfeld, 2002).

Diversity in species influences the adaptive capacity of ecosystems: "Species play different roles in ecosystems, in the sense of having different effects on ecosystem processes and/or different responses to shifts in the physical or biotic environment (i.e., they occupy different niches). Species loss, therefore, affects both the functioning of ecosystems and their

potential to respond and adapt to changes in physical and biotic conditions" (Rockström, Steffen, Noone, Å. Persson, et al., 2009: 32). When ecosystems have low response diversity they are more vulnerable to the loss of select species as ecosystem functions can no longer be performed. However, managerial approaches that maintain a balance of both diversity and redundancy are ideal. High levels of diversity and redundancy are inefficient and costly to maintain leading to inefficiency (Biggs et al., 2012a). While low levels of diversity and redundancy cause brittleness and vulnerability (Biggs et al., 2012a). Vulnerability can be caused by both low and high levels of diversity (Biggs et al., 2012a). When systems are fragile even small disturbances can have a large effect (Holling, 2001). Furthermore, the effects of disruption do not stop at the system directly connected to the disturbance, but change also cascades across scale to other connected systems (Gunderson & Holling, 2002).

While ecosystems have a natural capacity to adapt, this capacity is only able to withstand impact up to a certain threshold. Once this threshold is passed, the resilience of the system declines when it is no longer able to adapt to the intensity and frequency of the impact from corporate activities. After the threshold is past, the ecosystem starts to operate in a different regime, cycling through different patterns of resilience and driven by different controlling variables. In a new regime, the ecosystems that corporations depend on are vulnerable to new feedbacks and the system behaves in a different manner than before (Walker & Salt, 2006). Therefore, we suggest the following propositions:

Proposition 3a: When managerial approaches do not monitor functional redundancy and response diversity of ecosystems in which they operate, important cues on cross-scale resilience may be overlooked leading to cross-scale vulnerability

Proposition 3b: Managerial approaches that maintain functional redundancy and response diversity of ecosystems in which they operate will enhance cross-scale resilience

We illustrate these propositions by showing how the collective impact of palm oil and tropical timber production disturbs the natural adaptive cycle of local and regional ecosystems. The Bornean rainforests naturally shift through phases of destruction, reproduction and growth. The natural adaptive cycle of the rainforests is driven by El Niño events which trigger local droughts and then mass reproduction of trees and fauna (Rockström, Steffen, Noone, Å. Persson, et al., 2009 Appendix 1; Whiteman et al., 2013). El Niño events trigger the renewal phase by regenerating the forest and biodiversity which are the source of the ecosystems' long-term resilience. "The rainforest has evolved ecologically to turn crisis … into opportunity for continuous development" (Rockström, Steffen, Noone, Å. Persson, et al., 2009: 6 Appendix 1).

However, mass production of palm oil and timber extraction disrupts the natural ecosystem cycling of the rainforests. Fueled by the economic demand for palm oil and tropical timber, these large-scale production activities cause land use change and biodiversity loss. Indonesia is the largest producer of palm oil worldwide and together with Malaysia accounts for more than 80% of the global supply (Levin, Ng, Fortes, Garcia, & Lacey, 2012). Production of palm oil continues to increase annually in Borneo with further virgin forest cleared, peatland drained and land burned for (often illegal) expansions of palm oil plantations. Between 2005 and 2015 palm oil plantations on Borneo expanded from 2.4 million ha to 7.0 million ha (Wulffraat, Greenwood, Sucipto, & Faisal, 2016). Combined with El Niño events they act as destructive forces preventing natural regeneration and resulting in degradation of the rainforest. The ecosystem is unable to enter the renewal phase of the adaptive cycle thereby regenerating the forest. The aggregated effect of firms demanding palm oil represents a revolt connection in nested adaptive cycles, cascading upwards to disrupt the adaptive cycle of the rainforest. As a result the region is more vulnerable to extreme weather events generated at a global level which causes more droughts, and fires intensifying the release of carbon into the atmosphere, further adding to climate change.

Unilever is aware of ecosystem degradation in Borneo and actively works to address the issue. Unilever co-founded the Roundtable on Sustainable Palm Oil (RSPO), a multi-stakeholder initiative established to promote the production and use of sustainable palm oil, in 2004. The RSPO provides voluntary certification to palm oil producers based on a set of principles and criteria for social and environmental practices. Unilever continues to work with the platform and is committed to 100% physically traceable and certified sustainable palm oil by 2019 (Unilever, 2018d). By 2016, 36% of its sourced palm oil was certified (Unilever, 2018d), above its target of 30% for the year (Unilever, 2016). Currently, the RSPO has certified a total of 11.83 million tons of industry palm oil annually representing 19% of the global market (RSPO, 2018).

The RSPO has anecdotally realized many local improvements for environmental, social and economic criteria, but is yet to fully "demonstrate real impact at a macro-level" (RSPO, 2017: 3). In addition, the RSPO has faced fierce criticism from international NGOs, who have accused it of insufficient sustainability criteria and legitimizing deforestation, while some members of RSPO have been found in breach of set standards (Greenpeace, 2008). In 2014 Paul Polman reflected that Unilever's efforts are not yet tackling deforestation at the scale required (Polman, 2014b). The gap between Unilever's environmental strategy and declining ecosystem resilience is not lost on Paul Polman (2014b): "Deforestation is not just one of the great challenges in the fight against climate change… It is the most important, immediate and urgent challenge, in my opinion. We are not yet acting at either the speed or scale that the problem demands. But we can win this battle." It is becoming increasingly clear that the RSPO has to date been unable to allow the Bornean ecosystem to re-enter its natural adaptive cycle and effectively stop the removal of vital carbon sinks that mitigate climate change.

In January 2018 at the World Economic Forum, Unilever announced a further commitment to sustainable palm oil production practices and ending deforestation (Unilever, 2018e). In hopes of accelerating sustainable palm oil production, Unilever signed a memorandum of understanding with

a government owned palm oil production company in Indonesia. Unilever positions the agreement as unique to the industry and hopes it will halt deforestation, development on peat and human rights violations. In February 2018, the company revealed the details of its palm oil production supply chain (Eco-Business, 2018). Transparency in the supply chain is thought to radically transform the industry and continue the company's efforts to make sustainable palm oil production a reality. In January 2018, the company furthered its commitment to addressing deforestation.

Despite these efforts, the social-ecological systems of Borneo, a major supplier of palm oil to Unilever and its competitors, remain under threat in a prolonged state of environmental crisis (Rockström, Steffen, Noone, Å. Persson, et al., 2009; Whiteman et al., 2013; Wulffraat et al., 2016). In fact, Borneo continues to lose ecosystem resilience at an alarming rate. Lowland rainforests, which represent critical habitats for many rare species but are also optimal sites for palm oil plantations, have become particularly degraded, being decimated to only 43% of their original coverage by 2015, and projected to be only 32% by 2020 (Wulffraat et al., 2016). Borneo's forests remain in a prolonged state of crisis because of a loss of response diversity and functional redundancy—by replacing a more diverse forest cover with mono-cultural palm oil plantations, the forest is less able to utilize El Nino events, withstand drought and forest fire threats. The RSPO is unlikely to be able to tackle such cross-scale resilience because it does not explicitly integrate adaptive nested cycles into its management principles.

Discussion

By diving deeper into the cross-scale dynamics of nested adaptive cycles and social-ecological resilience concepts, this paper contributes to a conceptual basis that examines resilience across temporal scales and across nested social-ecological systems which affect and are affected by organizational action. Our illustrative example has helped demonstrate how organizational action alters the natural adaptive cycles of ecosystems

(King, 1995; Nyström & Folke, 2001) and organizational resilience is influenced by dynamics of these broader systems. Organizational resilience is thus interconnected with the provision for ecosystem services and the impacts on ecosystems will feed back to organizations over time (Clément & Rivera, 2016).

In Figure 3.1, we take a focal scale of the Bornean Rainforests and depict the disruption caused by collective corporate impact to the natural cycling of the ecosystems in Borneo (see also Table 3.1). We also show how changes to the cycling of the rainforests in Borneo also impacts ecosystems at different scales and the livelihood of local communities. We discuss this diagram in detail now.

On the right hand side of Figure 3.1, are the natural, economic and social factors contributing to the prolonged ecological decline and vulnerability of the Bornean rainforests. The extraction of timber and production of palm oil (as a result of global economic demand by companies such as Unilever) results in clearing of virgin forest. The replacement of virgin forests with mono-cultural palm oil plantations reduces biological diversity and redundancy leading to a decline in resilience. Because the ecosystems are in a fragile state, when El Niño events strike, the impact of the events are too great for the ecosystems to adapt. Despite best efforts, governance mechanisms such as the RSPO have yet to effectively restore local ecological resilience. The combination of these factors overtime, disturbs the natural adaptive cycle of the Bornean Rainforests, contributing to a decline in ecosystem system resilience.

The inability of the ecosystems to adapt, or to transition from the release to the reorganization phase of the adaptive cycles, leads to a number of cross-scale social and ecological consequences. The consequences of loss of ecosystem resilience are shown at the end of the arrows steaming from the broken adaptive cycle. Local social systems are impacted through

Figure 3.1 Cross-Scale Vulnerability in Bornean Rainforests

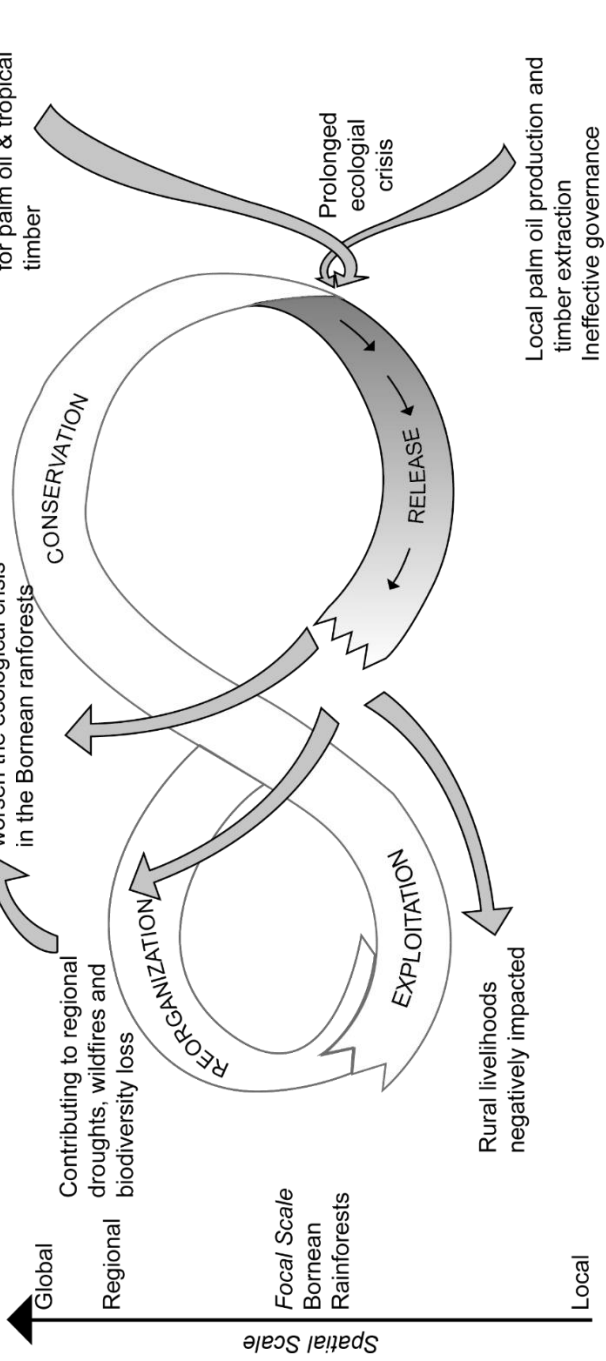


Table 3.2 The Adaptive Cycle, Bornean Rainforests

Phase of the adaptive cycle	**Front loop** From exploitation to conservation	**Back loop** From release to reorganization
Description	The natural adaptive cycle of the Bornean rainforests is disrupted by the mass production of palm oil and timber extraction. The ecosystems are no longer able to enter phases of renewal and rapid growth.	The Bornean rainforests are suffering from a prolonged ecological crisis. El Niño events now trigger destructive forces due to land use change and declining biodiversity.
Mechanisms triggering the next phase	Global economic demand for tropical timber and palm oil Destructive El Niño events	Currently the rainforests are unable to enter the front loop Effective governance and ecosystem restoration could be solutions to social engineering a solution triggering the front loop again
Conditions prolonging the phase	Currently the ecosystems are not able to enter the front loop of the adaptive cycle	Local palm oil production and timber extraction Ineffective governance

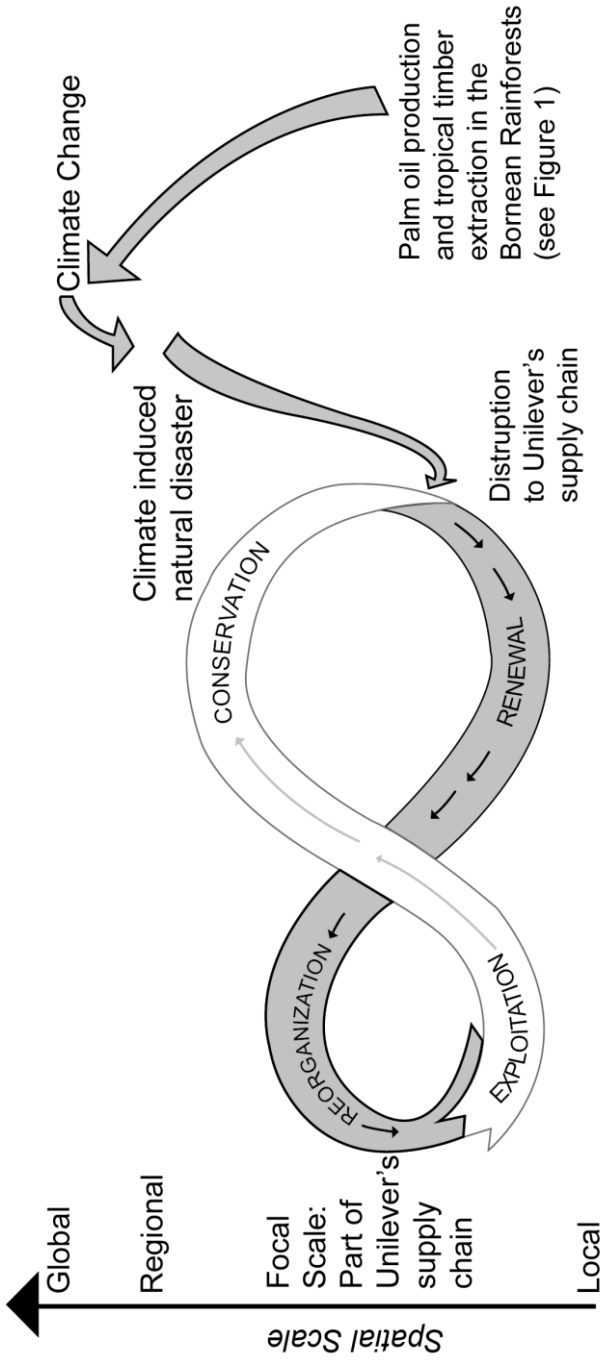
property damage, loss of life and loss of economic activity. Loss of resilience contributes to regional droughts, wildfires and biodiversity loss. The effects cascade across scale and impacts the global climate system and strengths the effects of the El Niño events. Consequently, the cascading effects feedback to further worsen ecological fragility in the Bornean rainforests.

Figure 3.1 demonstrates important social-ecological dimensions that are not currently captured by organizational resilience scholars. While the organizational literature has begun to recognize that nested adaptive cycles are a useful framework to analyze organizational resilience across spatial

and temporal scales of organizational subsystems (Yang et al., 2014), due to a spatial scale bias (Proposition 1), this work remains detached from the functioning of broader social-ecological systems beyond the firm level (for an exception, see King, 1995). Some work suggests that organizational resilience is dependent on the resilience of broader systems (Clément & Rivera, 2016), but stops short of providing specific examples of how managers might approach this dependency. Our key contribution is to conceptually show how the adaptive cycle of cross-scale resilience may be relevant for a multinational corporation (such as Unilever) that has significant impacts on social-ecological ecological resilience across scales. We also argue how, issues of scale (Proposition 1), slow moving variables (Proposition 2), and diversity and redundancy (Proposition 3) are important for enhancing social-ecological resilience (Biggs et al., 2012a, 2015). In our illustration, declining ecosystem diversity and redundancy has cascading effects across social and ecological systems (see Figure 3.1). To restore cross-scale resilience, managers can influence the levels of diversity and redundancy in the systems in which they operate (Proposition 3).

In Figure 3.2, we take a different focal scale and show how changes in Borneo (which lead it vulnerable to massive wildfires) affect the global climate system and affect the planetary adaptive cycle which increases the incidence of extreme weather events. In turn, these extreme weather events can disrupt Unilever's supply chain in other geographic regions. On the right side, Figure 3.2 shows that effects of extreme weather events felt in Unilever's supply chain are in part due to the decline in social-ecological resilience in Borneo due to its effects on the global climate system. Figure 3.2 demonstrates that Unilever (and other companies) suffer the consequences of declining resilience in Borneo when the effects contribute to climate change at a global scale and feedback causing a climate-related disruption in the company's supply chain—in adaptive cycle terminology, this causes a shift from the front-loop of the adaptive cycle to back-loop.

Figure 3.2 Cross-Scale Feedbacks in Unilever's Supply Chain



From a firm-level or supply chain perspective, the adaptive cycle demonstrates that organizations suffer decreases in organizational performance due to extreme weather events and respond to the impacts of events to quickly return to normal levels of performance (Linnenluecke & Griffiths, 2010). This work focuses on the consequences of loss of ecosystem resilience and organizational responses to those consequences. Due to a spatial scale bias (Proposition 1), this work potentially overlooks the role of organizations in creating and driving abrupt ecological change at other scales (see Figure 3.1). Instead of building organizational resilience to "climate change and weather extremes" (Linnenluecke & Griffiths, 2010: 4988), taking a systemic perspective, managers could build cross-scale resilience including the systems on which organizations depend.

We found no public evidence that Unilever is connecting the dots between such slow and fast moving variables with respect to the focal system of Borneo as described above. However, we argue that the company could do so. A cross-scale approach requires knowledge about the functioning of broader social and ecological systems (see Figure 3.1), managerial approaches that take a complex adaptive systems perspective (Proposition 1), monitoring of slow variables and feedbacks (Proposition 2) and strategies to maintain important system elements such as diversity and redundancy (Proposition 3).

Managerial Implications

Intervening in social-ecological systems to build resilience across scales requires careful managerial attention focusing on the spatial and temporal dimensions of nested adaptive cycles. Firms need to develop an understanding of the interconnections between their activities and these higher and lower order systems (Proposition 1). Managers may seek to answer questions such as; 'how may lower order systems act to disturb organizational behavior?' And, 'How may higher order systems influence the behavior of organizations?' And, 'How might strategies and processes contribute to building resilience of the entire system?' This information is

not used in search of simplifying or controlling the complexity of the system, but rather to exploit complexity in order to unlocking mechanisms that may support building resilience (Waddock, Meszoely, Waddell, & Dentoni, 2015). To manage systemic cross-scale change, understanding the structure of the system allows for identification of leverage points to intervene in the system to fundamentally change the behavior of the system (Meadows, 2009).

Firms may also need to change the focal scale in which they place managerial attention (Proposition 1) in order to develop capabilities to search for and interpret information about the cycling of higher and lower order systems (King, 1995; Linnenluecke & Griffiths, 2010). Information concerning the phase in the adaptive cycle and patterns of resilience may help firms to gain clarity regarding how to intervene to build cross-scale resilience. For instance, by identifying that local ecosystems are increasingly vulnerable due to loss of diversity and redundancy, a manager may proactively seek organizational strategies that help to build and monitor diversity and redundancy (Proposition 3) to push the ecosystem into the renewal phase of the adaptive cycle. This may then avoid the negative consequences of ecosystem collapse for the organization itself.

An outstanding question is, how could Unilever's corporate strategy and actions regarding Borneo change? How can managerial practices adapt to foster cross-scale resilience? First, Unilever could take a complex adaptive systems view of cross-scale resilience (Proposition 1). This approach would pay attention to subtle social-ecological dynamics in the systems in which the company operates. Our propositions suggest that slow moving variables (Proposition 2) and levels of diversity and redundancy (Proposition 3) are several factors for Unilever's managers to consider. Unilever could then develop strategies that *build cross-scale resilience*. For instance, Unilever could consider how it can restore ecosystem resilience in Borneo. Land restoration practices help mitigate climate change by reducing emissions and improving sequestration while also addressing the consequences of climate change by reducing risks at the landscape level (FAO & Global Mechanism of the UNCCD, 2015). Product diversification may reduce the

negative effects of large scale monocropping resulting in biodiversity loss. As a result, Unilever would both support the ecosystem to circulate the adaptive cycle from collapse into renewal and help to protect the long-term health of its own organization.

Conclusion

In the wake of increasing ecosystem volatility induced by climate change, interest in organizational resilience is growing with managers keen to become more adaptive and protect their organizational assets and revenue streams. Yet, we currently have little knowledge of how efforts to enhance organizational resilience may interfere with the natural adaptive cycle of ecosystems, detract from social-ecological resilience and feed back to the organization over time and across spatial scales. We believe that the natural sciences offers organizational scholars the conceptual basis to move towards a more holistic understanding of cross-scale resilience and the crucial role of organizations. We invite organizational resilience scholars to further explore both the ways in which managers may understand cross-scale connections, and how managers may form organizational strategies that seek to build the social-ecological resilience that their firms depend upon for long term survival.

CHAPTER 4 SYSTEMIC PLANETARY RISKS: IMPLICATIONS FOR ORGANIZATION STUDIES[3]

Abstract

The scale of environmental risks has changed over time from locale-specific threats to threats arising at a planetary level. Now, managers face planetary risks that pose a significant threat to humanity. However, the complex role of organizations as collective contributors to and recipients of systemic risks at the planetary level remains underexplored in organization studies. Building upon advances in the natural sciences, this chapter presents a three-phase framework for analyzing systemic planetary risks and considering the role that collections of organizational actors play in producing these risks. The framework thus examines 1) building a planetary view of organizational risk across scales, 2) understanding planetary risks and 3) building organizational and societal adaptive capacity for managing planetary risks.

[3] A version of this paper is forthcoming in *The Routledge Companion to Risk, Crisis, and Emergency Management:* Whiteman, G. & Williams, A. Systemic Ecosystem Risks: Implications for Organization Studies. In: Gephart, R., Miller, C. & Svedberg Helgesson, K. (eds) *The Routledge Companion to Risk, Crisis, and Emergency Management*. Routledge. Forthcoming.

Introduction

Environmental risks to humans are not new—history is replete with examples of societies that collapsed alongside ecosystem change (Diamond, 2005). We know that numerous societies that have suffered because of environmental pollution from organizational operations (King & Lenox, 2000; Maguire & Hardy, 2009, 2013) and from industrial accidents (Gephart, 1984; Tsoukas, 1999).

However, the scale of environmental risks has changed over the course of the 20th century from locale-specific threats to those arising at a planetary level (Rockström, Steffen, Noone, A. Persson, et al., 2009; Rockström, Steffen, Noone, Å. Persson, et al., 2009; Whiteman et al., 2013). Natural scientists now estimate that four of the nine essential planetary processes needed to sustain life have exceeded safe thresholds and now represent significant risks to humanity (Rockström, Steffen, Noone, A. Persson, et al., 2009; Rockström, Steffen, Noone, Å. Persson, et al., 2009; Steffen, Richardson, et al., 2015). In particular, climate change and land-system change are well past safe thresholds and have entered the zone of increasing risk where the rate of biodiversity loss and phosphorus and nitrogen release pose high levels of planetary risk. In such a world, organizational "processes of risk calculation used in modern society fail to work in risk society because risks are no longer localized and are long term in nature" (Gephart, Van Maanen, & Oberlechner, 2009: 145).

Natural scientists further argue that there are solid data to suggest that organizational and economic activities over time have been the driving force behind the planetary shift away from the stable Holocene period into what has been called the Anthropocene (Steffen, Broadgate, Deutsch, Gaffney, & Ludwig, 2015). The Anthropocene is what Nobel prize winner Paul Crutzen and colleagues describe as period of time commencing with the industrial revolution where human impact on the environment became the paramount force of change (Steffen, Crutzen, & McNeill, 2007). The central role of organizations within these shifts seems likely.

However, the complex role of organizations as collective contributors to and recipients of systemic risks at the planetary level remains underexplored (Winn et al., 2011). While the organizational risk management literature is vast, organizational studies of risk seldom integrate environmental threats into conceptual frameworks (cf., Bundy, Pfarrer, Short, & Coombs, 2017). In addition, the handful of studies on environmental risk within the corporate sustainability literature are firm-specific and focus more on supply chain or operational risks from specific natural events – in terms of extreme weather (e.g. Linnenluecke & Griffiths, 2013)– or risks to the natural world through organizational accidents eg., Exxon Valdez (Shrivastava, 1994b) or Deepwater Horizon (Bozeman, 2011). Integration of planetary risks to, and from, collections of organizational actors over time is lacking.

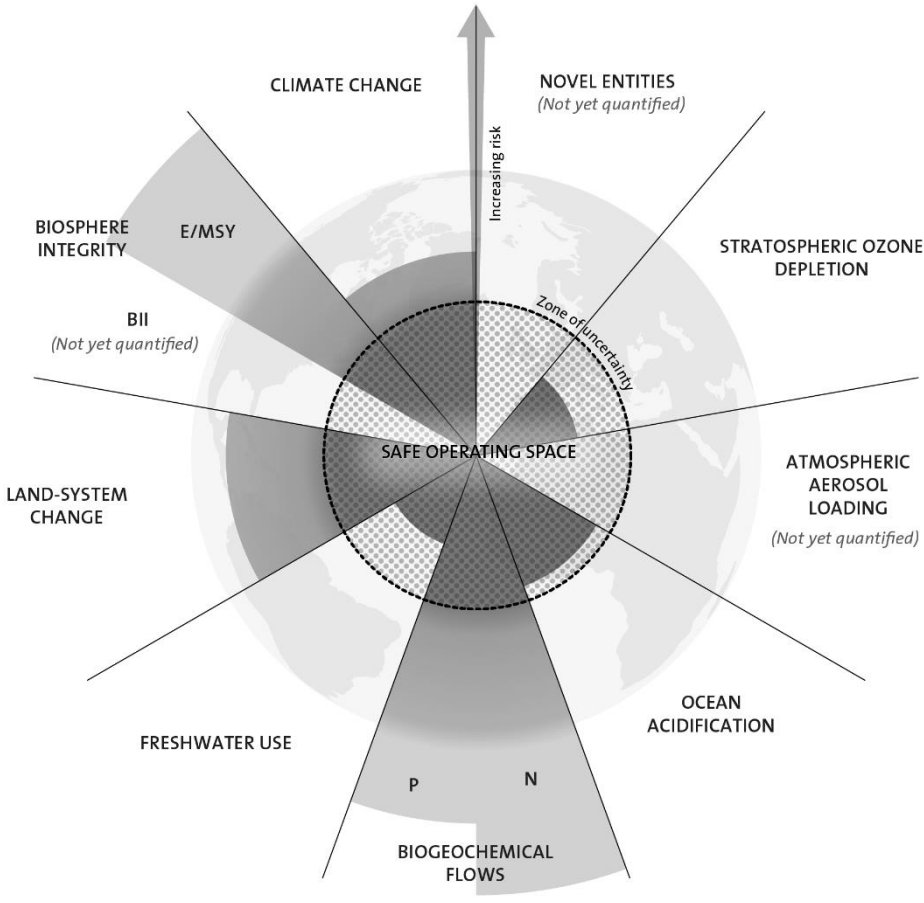
The aim of this chapter is to address these gaps. We ask the question, 'How can researchers of organization theory collaborate with managers of organizations to better conceptualize systemic ecosystems risks and develop strategies to ensure these are addressed?' Building upon advances in Earth System Science, we present a framework for analyzing systemic planetary risks and consider the role of collections of organizational actors. Our chapter is organized as follows: we first set the broader context by reviewing the literature on environmental risk at the planetary scale and on global business discussions on risk. We then review the organizational literature on environmental risks and identify the gaps in the organizational literature evident from the issue addressed in systemic research on environmental risk at the planetary scale. To help address these gaps in our understanding of organizations and risk, we present a framework that encapsulates a systemic view of social-ecological risk and organizations. We close with a discussion of future research needs.

The Landscape of Planetary Risk

To support more effective risk management at the global level, earth system science indicates that there are 9 key global ecosystem processes that collectively interact to create a "safe operating space for humanity" (see

Figure 4.1) (Rockström, Steffen, Noone, A. Persson, et al., 2009: 474; Whiteman et al., 2013). These processes include climate change, biochemical flows of phosphorus and nitrogen, freshwater use, land-system change, biosphere integrity (biodiversity); ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading (air pollution); and novel entities (chemical pollution).

Figure 4.1 Planetary Boundaries and Safe Thresholds



Source: Steffen et al. Planetary Boundaries: Guiding human development on a changing planet, *Science,* 16 January 2015a. (Credit: F. Pharand-Deschênes /Globaïa)

The nine boundaries are dynamically interconnected so risks in one area will trigger increasing risks in others. An analysis of systemic risk factors at the planetary level which captures both spatial and temporal dimensions is thus important. For some parts of the world, including the Arctic and drought-ridden parts of Africa, the United States and Australia, climate change impacts are happening already (2018) (droughts, floods, fire, etc.; cf. IPCC, 2015) alongside of degradation of land, water and air pollution (see Le De and Shrestha, 2018, this volume). In other parts of the world, planetary risks are the most serious under future scenarios – thus risks may be mitigated to some extent if deep de-carbonization occurs in the near-term. While the highest risks of climate change or ocean acidification have not yet materialized into catastrophic tipping points, the window of opportunity to address the increasing (and significant) risks of climate change is closing fast (Figueres et al., 2017). Thus, planetary risk management requires that the world deal urgently with the emissions crisis in the near-term, in order to provide us with a safer space to tackle other entrenched ecosystem problems.

Scholars have identified the period since WWII as the "Great Acceleration," whereby industrial processes dramatically accelerated their impact on the structure and functioning of key ecosystem resources including rapidly increasing levels of carbon dioxide, nitrous oxide, methane, stratospheric ozone loss, surface temperature, ocean acidification, tropical forest loss and terrestrial biosphere degradation (Steffen, Broadgate, et al., 2015).

While causality has yet to be conclusively proven, given the complexity of these effects, it is highly plausible that cumulative and collective organizational action is correlated with or related to systemic degradation of the planet's key ecosystem processes. Furthermore, these human-led impacts have, over time, introduced a new landscape of planetary risk that poses complex and uncertain threats for humanity and for the organizations that collectively make up the world as we know it (see Rockström, Steffen, Noone, A. Persson, et al., 2009; Rockström, Steffen, Noone, Å. Persson, et al., 2009; Steffen, Richardson, et al., 2015; Whiteman

et al., 2013). Natural science data thus support the social science argument (Beck, 1992; Beck & Holzer, 2007) on risk societies: that "the success of the wealth- generating industrial society has produced a situation in which the risks and problematic by-products of wealth generation have become the new basic organizing principle and a key concern for society (Lupton 1999b, pp. 59)" (in Gephart et al., 2009: 145). We argue that this is an area ripe for conceptual and empirical development for organization studies.

Organizational Literature on Risk and the Natural Environment

The literature on risks and the natural environment has shown that organizations can reduce vulnerability to risks by preparing for potential disturbances and by developing coordination techniques within organizations and with other stakeholders (T. A. Williams et al., 2017). Two main streams of research explain how managers prevent crises through effective risk management. The internal perspective focuses on organizational preparedness and how managers build capabilities to manage unexpected events (Bundy et al., 2017). For example, research on high reliability organizations demonstrates that effectively correcting errors and remaining flexible can prevent crisis (Weick & Sutcliffe, 2001). The external perspective suggests that relationships with stakeholders influence managerial capacity to manage risks (Bundy et al., 2017). Relationships with stakeholders can provide the knowledge and resources necessary to facilitate recovery after a crisis (Williams & Shepherd, 2016 Le De and Shrestha).

A review of the management literature suggests: (1) the natural environment is notably absent from leading organizational risk frameworks as is the case with Figure 1 in Bundy et al. (2017: 1665), with the implicit assumption of a stable natural environment, or one that faces linear change; (2) risk studies from the corporate sustainability literature are either focused on episodic threats from natural environment (e.g., through extreme weather) or are focused on organizationally produced risks to the natural environment through industrial accidents; and (3) there are limited

studies that examine systemic feedback loops between organizations and dynamic ecosystem processes facing threats (See Table 4.1). In Table 4.1, we provide an overview of the literature along two dimensions. First, we examine if environmental risks are considered at a discrete point in time or a risk that unfolds as a process over time and space. Then we consider the directionality of the threat.

Table 4.1 Risk Literature Concerning the Natural Environment

Risk Type	**Discrete Events**	**Processes Over Time**
Studies focused on threats from the natural environment to organizations	Mann Gulch (Weick, 1993) Victoria Bushfires (Linnenluecke & Griffiths, 2013) Climate risks (Beermann, 2011; Berkhout, Hertin, & Gann, 2006) Droughts and floods (Gasbarro, Rizzi, & Frey, 2016) Pollution (Dobler, Lajili, & Zéghal, 2014) Hurricanes (Delp, Podolsky, & Aguilar, 2009)	Supply Chain Risks (Hofmann, Busse, Bode, & Henke, 2014)(Hofmann et al., 2014) Chemical industry supply chain risk (Kleindorfer & Saad, 2005) Mann Gulch (Whiteman & Cooper, 2011) Social and environmental practices (Ortiz-de-Mandojana & Bansal, 2016) Climate change (Hahn et al., 2015; Pinkse & Gasbarro, 2016)
Studies focused on organizational threats to the natural environment	Bhopal (Shrivastava, 1992) Oil spills (Pauchant & Mitroff, 1992) Fukushima Other toxic releases High risk technologies (Gephart, 2004)	Climate risks (Kolk & Pinkse, 2005) Sustainable energy (Kondoh, 2009) Eco-certification (Melo & Wolf, 2005)
Systemic Studies examining the feedback loops across organizations and between socio-ecological systems	Firm contribution to climate change and climate impacts on the firm (Weinhofer & Busch, 2013)	Toledo water supply and Lake Erie phosphorus bloom (Whiteman & Kennedy, 2016)

On the positive side, organizational researchers recognize that numerous companies, including the insurance sector, have begun to seriously consider the threat of climate change over the last ten years, but

have failed to integrate climate change risk into corporate governance structures (Thistlethwaite, 2012; Thistlethwaite & Wood, 2016). Despite a relatively late recognition of the need for corporate sustainability research to focus on climate change (Goodall, 2008), there is now a good understanding of drivers of carbon reporting and lobbying, clear knowledge of institutional drivers of carbon accounting regimes, evidence of financial risks for a firm from climate change (Hahn et al., 2015), and a growing understanding of the physical risks from climate change such as those from extreme weather (Linnenluecke & Griffiths, 2013; Weinhofer & Busch, 2013). There is also continuing research focus on managing the risks from natural disasters or extreme weather events – fires, floods, drought -- both in terms of supply chain risk and response (Linnenluecke & Griffiths, 2013) and philanthropic disaster response (Muller & Whiteman, 2009). In addition, the organizational adaptation literature has concentrated on enhancing organizational resilience in the face of the consequences of climate change (Linnenluecke & Griffiths, 2010; T. A. Williams et al., 2017). Collectively, these studies provide new insights into risk management, noting that organizations can build resilience and adaptive capacity by creating network responses, sense-making capabilities and encouraging flexibility (Linnenluecke & Griffiths, 2013).

Research also shows that risk perception is an important factor in determining a firm's selective attention to climate change risks; however, firms tend to focus on short-term risks that are of immediate concern for business decisions (Pinkse & Gasbarro, 2016). A temporal bias thus prevents firms from considering risks that will materialize in the distant future (Pinkse & Gasbarro, 2016). Managers tend to overlook risks when the temporal and spatial attributes, or scale of the processes related to the risk being observed, are not aligned with their cognition (Bansal et al., 2018). Corporations that operate in more dynamic and competitive environments are more likely to implement adaptation strategies in the face of climate risks (Berkhout et al., 2006). Companies that perceive long-term organizational survival is threatened by climate change are more likely to invest in risky environmental technologies to enhance organizational

resilience (Kolk & Pinkse, 2008). Climate change may jeopardize long-term organizational survival. Nuclear power reduces carbon dioxide emissions but increases the nuclear threats such as exposure to radioactivity creating a risk tradeoff (Kondoh, 2009). In addition, if nuclear waste storage zones are in geographic areas which may be affected by rising sea levels or extreme weather, then new risks may arise.

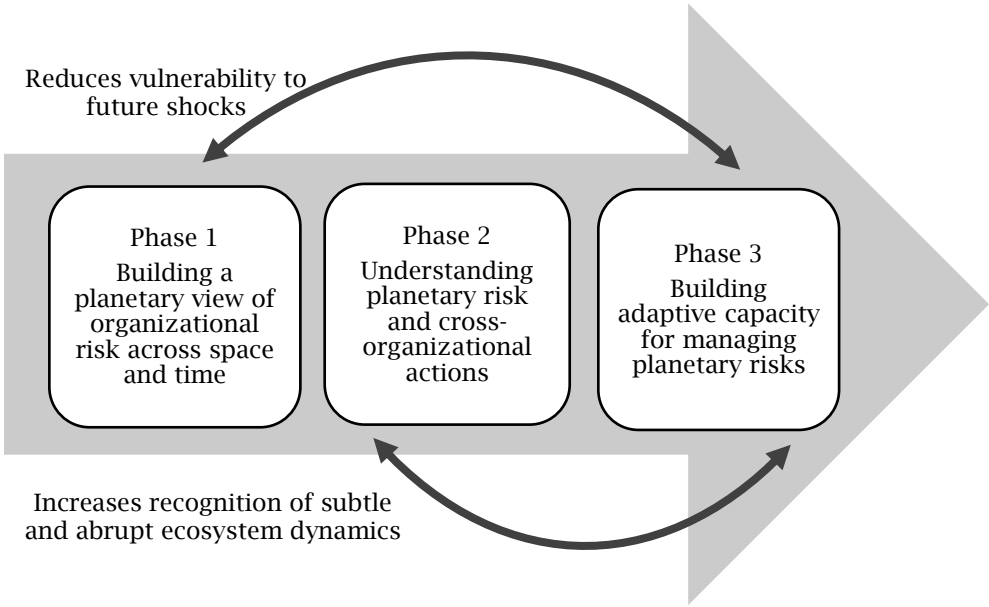
To date, there is little crossover between the corporate sustainability literature and the organizational literature on risk and crisis management, which implicitly assume a stable natural environment (cf. Bundy et al., 2017; Gephart et al., 2009). Overall, most studies are firm and industry focused and few, if any, attempt to analyze cumulative, interrelated systemic risks at global, regional and local levels over time (Whiteman et al., 2013; A. Williams et al., 2017). Integrative frameworks of organizational crisis and risk implicitly assume a stable (and therefore invisible) natural environment, which is not identified as an explicit variable or dynamic context shaping risk (Bundy et al., 2017). Firms' individual and collective actions also contribute significantly to global warming and other planetary boundaries, and co-create the threats that increase risks to their operations and financial stability. In the next section, we propose an integrative framework (Figure 4.2) to help organizational scholars examine feedback loops across organizations and between social-ecological systems.

A Framework for Analyzing Systemic Planetary Risks

The outstanding question for organizational scholars is how can we contribute to the conversation about systemic planetary risks? The answer, from our perspective, is three-fold: we can incorporate planetary risk into our view of organizational risk; secondly, we can help organizations make sense of planetary risks; and thirdly, we can identify how managers can build more adaptive capacity through systemic risk management programs across scale, and across organizational actors. To do so, we offer a framework (summarized in Figure 4.2) which consists of three iterative phases (1) building a planetary view of organizational risk across temporal

and spatial scales (2) understanding organizational actions in the context of planetary risks (3) building adaptive capacity to mitigate planetary risks.

Figure 4.2 A Framework for Analyzing Systemic Planetary Risks



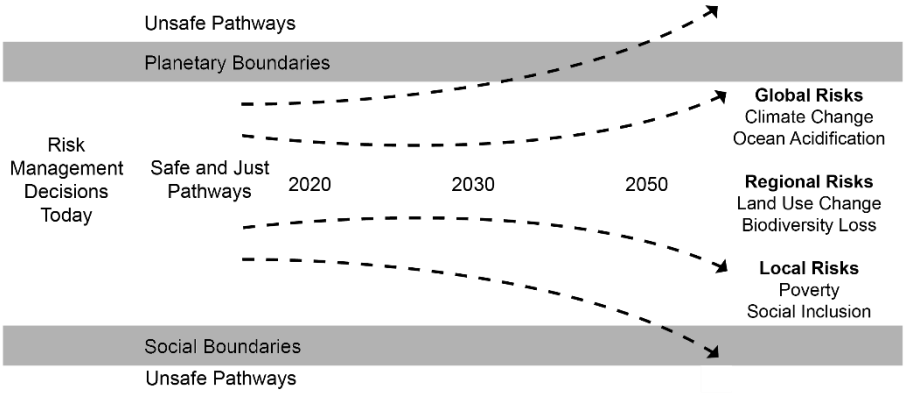
Phase 1: Building a Planetary View of Organizational Risk Across Temporal and Spatial Scales

Risks from climate change, lack of fresh water, land use pressures, air pollution (aerosol loading), ocean acidification, and chemical pollution (or more broadly, the release of hazardous entities) pose significant material risks to companies and societies – and critically can be tied back to economic activity across companies and organizations over temporal and spatial scales (Clift et al., 2017; Steffen, Richardson, et al., 2015; Whiteman et al., 2013). Planetary risks are systemic in nature and need to be examined at local, regional and global levels (Steffen, Richardson, et al., 2015; Whiteman et al., 2013).

We therefore suggest that risk management decisions today need to be influenced by an understanding of these ecosystem risks which are

interconnected at global, regional and local scales over time. Figure 4.3 depicts safe and unsafe risk pathways in relation to planetary boundaries, shows trends in global, regional and local risks over time and provides the background for the discussion that follows.

Figure 4.3 Cross-Organizational Planetary Risks Over Time and Space



Companies can take a long-term perspective to evaluate which risks could materialize at different time scales, and assess both the materiality of those risks to firm operations, and unintended externalities that arise from organizational actions which may amplify planetary risks. Integrating the planetary boundaries framework to risk management ensures that a more systemic approach is adopted which incorporates cross-organizational, cumulative organizational actions. This also reflects the growing systemic perspective of global economic actors such as the World Economic Forum which argues that "[a] key characteristic of global risks is their potential systemic nature – they have the potential to affect an entire system, as opposed to individual parts and components," (WEF, 2014).

The planetary boundaries framework (Figure 4.1) outlines the 9 key ecosystem processes which collectively delineates the safe space for humanity. By incorporating this framework into our discipline, a key implication is to explicitly consider how organizational actions contribute

(or detract) from pathways which may (or may not) lead to a safe space for humanity (Rockström, Steffen, Noone, A. Persson, et al., 2009; Rockström, Steffen, Noone, Å. Persson, et al., 2009; Steffen, Richardson, et al., 2015; Whiteman et al., 2013). Safe pathways are those that mitigate planetary risks. Unsafe pathways are those that (intentionally or unintentionally) amplify planetary risks.

A systemic perspective requires a cross-organizational collective view of planetary risks over both time and space. Issues of scale are important when managers identify risks (Bansal et al., 2018). We discuss these in more detail below.

Temporal scales. Temporal scale is "the patterned variations in processes over time," (Bansal et al., 2018: 12). Long-term organizational survival depends on managers capacity to manage intertemporal trade-offs (Bansal & DesJardine, 2014). Inability to manage short-term and long-term risks exposes the firm to risks across scales (Bansal & DesJardine, 2014). Figure 4.3 adopts a ten year time interval (up to 2050) given that global societal and economic risks have been defined as "an occurrence that causes significant negative impact for several countries and industries over a time frame of up to 10 years (WEF, 2014). In Figure 4.3, we have suggested time intervals including 2020, 2030, 2040 and 2050. Most of these intervals have coincided with existing globally agreed upon frameworks and scientific targets. The year 2020 has been proposed as the turning point for bending the global emissions curve in order to achieve the climate targets set by the Paris Agreement (Figueres et al., 2017). In addition, the UN Sustainable Development Goals (SDGs), agreed upon by 193 member states of the UN, set the global development agenda until 2030. The 17 SDGs and 169 targets set broad social and environmental goals. If seriously implemented by governments, regulations, and investment flows are expected to align with the SDGs. To account for future risks and opportunities, managers can map their current operations against the SDGs and align their strategy with the SDGs (see also Chapter 5). The SDG Compass, a guide for business action on the SDGs, provides advice for companies to understand the impacts of the SDGs (GRI, UNGC, & WBCSD, 2015). The guide suggests identifying high

impact areas and then evaluating the risks and opportunities that the prioritized areas present. The guide also identifies specific open access tools and indicators for each SDG that can be useful during the process. By 2050, climate scientists agree that net zero emissions should be reached (Rockström et al., 2017).

Our framework explicitly identifies these four intervals given the need for firm behavior to collectively be aligned with global agreements and scientific thresholds to mitigate long-term social-ecological risks. Managers can, in collaboration with scientists, further identify and refine time intervals such that they are most pertinent and relevant for firm-specific operations. Nevertheless, the collective systemic targets and time frames remain relevant for each firm as it operates within the collective behaviors of multiple firms and societies. In order to effectively and robustly evaluate future risks to and from the natural environment, managers should also account for cross-scale feedbacks over time. For example, infrastructure decisions made by countries, cities, and companies cannot be assessed without a systemic appreciation of risks from the natural environment. There are some encouraging signs that this approach is being applied in cities like London, which are evaluating green infrastructure decisions on transport, water and energy to both accommodate a growing population and make the city more resilient to the effects of climate change. In general, our framework suggests that organizational decisions made today will positively and negatively impact social-ecological systems over time and across different geographic scales. If the feedback from these decisions is not accounted for today, organizations will be left vulnerable to unexpected future shocks.

Spatial scales

Achieving sustainability requires addressing interactions across spatial scales (Starik & Rands, 1995). Spatial scale is "the geographical area in which the dominant process(es) of interest manifest," (Bansal et al., 2018: 12). In Figure 4.3, we have identified a number of organizational risks that materialize at global, regional and local spatial scales related to the

planetary boundaries processes. In order to do so, we build upon prior transdisciplinary work that considers the spatial implications of planetary risks to organizational behavior (Whiteman et al., 2013).

Using a spatial application of the planetary boundaries concept to organizations in the natural environment, Whiteman et al. (2013: 324) show that "corporate sustainability is anchored within an analysis of how the company (and industry at a higher scale) affects all nine boundary processes within specific bounded geographies – at the local, regional, continental, and planetary level." One empirical example of this type of approach is an organizational analysis of cumulative cross-scale risks from phosphorus overload in Lake Erie (Whiteman & Kennedy, 2016). This study used the Lake Erie water system as the focal unit of analysis rather than starting with specific organizational actors (e.g., farmers or agricultural companies). A spatial and temporal analysis necessitates a broader investigation of the biophysical processes surrounding Lake Erie as well as the collective and cumulative actions of multiple actors shaping the agricultural sector (e.g., regulators, seed manufacturers, farmers, fertilizer manufacturers, retailers, transportation, etc.), as well as those from shipping, recreation, retail and water management.

Figure 4.3 provides examples of risks that may arise at different spatial scales including global, regional and local (summarized on the right hand side of Figure 4.3). Thus, cross-organizational actions must simultaneously consider spatial and temporal scales across social, ecological, economic and organizational subsystems. A processual view collapses the notion that 'crisis' can be avoided but rather it is part of a complex process unfolding with risks to be limited or contained (Whiteman & Kennedy, 2016; T. A. Williams et al., 2017).

Phase 2: Understanding Planetary Risk and Organizational Actions

Organizational studies indicate that knowledge and information about risks is important for framing and deciding upon courses of action (Sullivan-Taylor & Wilson, 2009). When information is scarce the level of risk and exposure to the risk increases (Sullivan-Taylor & Wilson, 2009).

Encouragingly, 'real-world' discussions of global risk have begun to make sense of planetary risks. For example, each year, the World Economic Forum (WEF) issues an influential report on Global Risk. Based upon feedback from 750 global experts, WEF identifies the top risks facing world leaders, including the private sector (WEF, 2017). For much of its history, the WEF Global Risk Report has short-listed risks from civil unrest, war, market turbulence and supply chain disruption. But in recent years, the global landscape of risk changed and WEF's reports (e.g. WEF, 2017) recognize the natural environment and extreme weather as the source of the top risk to humankind – the threat of climate change was ranked as the #1 risk facing the world because of both the growing likelihood of this occurring and the increasing scope of the potential impacts. "Research indicates that unbridled anthropogenic climate change would be most likely to play out in a disruptive and irreparable way" (Schellnhuber, Rahmstorf, & Winkelmann, 2016: 650). WEF actively supports work on other planetary risks like water and has convened numerous workshops on the implications of planetary boundaries for various sectors, nations and within various types of organizations (Rockström, personal communication).

Economic discussions of planetary risks are also a topic within the corporate boardroom. Unilever, for instance, has explicitly considered planetary boundaries risks to and from their value chain (Clift et al., 2017). Planetary boundary processes such as climate change, freshwater use and nitrogen and phosphorus flows pose significant risks to food security at local and regional scales.

At the same time, such discussions remain better developed on single topic issues such as ozone depletion or the climate change front. For instance, Mark Carney, Governor of the Bank of England and Chair of the G-20 Financial Stability Board, argues that climate change poses physical, liability and transition risks to markets and firms (Carney, 2016: 2–4). More work is required to integrate the systemic nature of planetary risk into these arenas and to more effectively understand complex feedbacks across different spatial and temporal scales. Weinhofer & Busch (2013) suggest, for instance, that future research should examine a two-dimensional risk

perspective on climate change including both an 'inside-out' perspective which acknowledges the firm's contributions to climate change and an 'outside-in' perspective which acknowledges the impact of climate risks on the firm. However, they do not discuss the interaction of inter-related risks over-time. We do know that micro-level processes of reflection and interpretation are critical to understanding the threat of high risk technologies to the natural environment (Gephart, 2004). Furthermore, that ability to recognize subtle and abrupt ecological change across time and space can enhance organizational resilience (Whiteman & Cooper, 2011).

Here we argue that a cross-organizational understanding of planetary risks can be facilitated by combining local data on ecosystem change, and by using science-based boundary objects to formulate a collective strategy to address pressing global environmental issues (Whiteman, Williams, Kennedy, & Parker, 2018). Framing of global systemic risks may also be an avenue for organizational scholars to pursue. Bundy et al., (2017: 11), for instance, show that "leaders who frame crises as threats react more emotionally and are more limited in their efforts, while leaders who frame crises as opportunities are more open-minded and flexible."

Phase 3: Building Adaptive Capacity for Managing Planetary Risks

We explained how organizational risks in our complex planetary system can be understood, and we now suggest how managers could collectively build adaptive capacity to cope with long-term systemic risks.

When levels of uncertainty are high and information is scarce, management techniques which emphasize prediction and planning are insufficient (Sullivan-Taylor & Wilson, 2009). In order to cope with systemic long-term risks arising from transgressed planetary boundaries, managers can build long-term adaptive capacity to systemic ecosystem risks. A key implication of Figure 4.3 is for organization scholars to consider the interrelated risks of other social-ecological systems, such as biodiversity, nitrogen/phosphorus use, and ozone depletion on organizational adaptation strategies (Whiteman et al., 2013)(Whiteman et al., 2013), over time (Bansal & DesJardine, 2014). An example of this approach to

organizational studies of risk is found in Whiteman and Kennedy (2016) in their systemic analysis of the phosphorus threat facing the city of Toledo, Ohio.

The adaptive capacity of organizations within nested social-ecological systems is one of the key mechanisms to managing planetary risks. Adaptability is "the capacity of actors in a system to influence resilience," (Folke et al., 2010: 3), in order to "avoid crossing into an undesirable system regime, or to succeed in crossing into a desirable one" (Walker & Salt, 2006: 163). To respond effectively to systemic shocks arising from increasing volatility of the planetary system, organizations can build flexible and adaptive systems. Self-organizing systems tend to be highly adaptive. Heightened understanding of ecological risks may initiate organizational adaptation strategies to build the required resilience (Clément & Rivera, 2016). For instance, studies have shown that considering how to manage risks posed by climate change, mitigation can improve long-term resilience capabilities (Beermann, 2011). Yet adaptive capacity to climate change cannot be developed in isolation from other planetary boundaries. For example, land degradation, another planetary boundary, is affected by climate change and at the same time contributes to climate change as there is less carbon storage in woodlands, etc. Such risks are intrinsically intertwined and adaptive capacity is a cross-organizational and systemic phenomenon.

After an understanding of the planetary system is developed, managers may build adaptive or transformative capacity to cope with long-term risks. For example, managers of high reliability organizations (HROs), or organizations in high risks industries which never fail, build adaptive capacity for organizational resilience (Weick & Sutcliffe, 2001).

Research also suggests that the resilience of ecosystem services is enhanced when governance systems encourage learning and experimentation, foster an understanding of complex systems, promote participation and implement polycentric governance (Biggs et al., 2012b). Managers can thus encourage diversity and redundancy as well as manage feedbacks and connectivity to enhance the resilience of ecosystem services

(Biggs et al., 2012b; Winn & Pogutz, 2013). More resilience is not necessarily better. Often systems that are too resilient, become rigid and unable to undertake necessary change until it is too late (Walker et al., 2004). When adaptation limits are reached, transformative change may be necessary (Clément & Rivera, 2016; Walker et al., 2004) which may in turn require the reduction in resilience within the old system. Resilience of existing structures and behaviors must be reduced in order to introduce new variables into the system to allow for transformative change (Walker & Salt, 2006). (Ecological) transformability is "the capacity to create a fundamentally new system when ecological, economic or social structures make the existing system untenable" (Walker et al., 2004). Organizations, including companies, have important roles to play within the transformation of market systems through eco-innovation and novelty (Kennedy, Whiteman, & Van den Ende, 2013; Loorbach et al., 2009).

Given the spatial scale of global risks (see Figure 4.3), we suggest organizations need to build adaptive or transformative capacity collectively. For example, research on recovery operations after New Zealand earthquakes finds that organizations embedded in strong networks are able to better organize after a disaster (Stevenson et al., 2014). If connectedness is low in networks of organizations, vulnerabilities to global risks may increase. Some network structures could be more vulnerable when a node is removed compared to others (van der Vegt, Essens, Wahlström, & George, 2015). Research on resilience in organizational networks would be particularly relevant for supply chains, where organizational connectedness is high. More knowledge is needed to understand cross-organizational resilience, adaptation, and transformation as responses to long-term global systemic risks.

Organizational scholars should also examine how cross-organizational governance structures influence responses to global systemic risks. Governance and compensation structure may influence the probability of a crisis (Bundy et al., 2017). Companies that wish to avert possible climate change risks may rely on changes in compensatory benefits (Kolk & Pinkse, 2005). Although research has yet to explore the impact of tying

compensation structures to global risks or to assess the subsequent impacts on organizational resilience, the structure of corporate boards may need to be revised to include a role for Chief Climate Officers or a Planetary Risk committee.

Conclusion

We proposed in this chapter that organizational studies of risk can benefit from the wealth of natural science insights on systemic ecosystem risks at the planetary scale. Hoskisson, Chirico, Zyung, & Gambeta (2017: 156) posit that the dominant organizational theories such as agency theory or the behavioral theory of the firm that are used to understand managerial risk taking tend to focus on solely on risks that are financial in nature. The authors argue that the boundary conditions of risk theories should be reconsidered. Alternative theories are needed to re-define risk taking and consider risks beyond firm-level financial risks (Hoskisson et al., 2017). This chapter contributes a long-term, systemic perspective on planetary risks that recognizes the embeddedness of organizations in the natural environment.

Further, given the ongoing escalation of planetary risks related to key ecosystem processes, we have proposed a three-phase framework for analyzing systemic planetary risks (Figure 4.2) that can contribute to reduction of these risks by establishing ways for organizations to build a planetary view of organizational risk across temporal and spatial scales, understand organizational actions in the context of planetary risks, and build adaptive capacity to mitigate planetary risks.

Critically, our framework highlights the importance of making managerial decisions as soon as possible to take into consideration safe pathways within the boundaries of the planet (Steffen, Richardson, et al., 2015). To manage the long-term systemic risks of organizations, we suggest principles of adaptive capacity and resilience can prepare managers for unanticipated risks from the natural environment and enhance managers collectively ability to respond to long-term planetary risks driven by

feedback loops across local, regional and global scales. One example is Action2020, the collective strategy of the World Business Council for Sustainable Development, which utilized the planetary boundaries framework to develop science-based targets for collective business action in order to explicitly mitigate systemic risks from the natural environment (see also Chapter 5).

We also note that our framework has limitations. In particular, we pay little attention to social risks in our framework (Leach et al., 2013). However, we recognize that planetary environmental risks are deeply intertwined with pressing societal issues, and the interaction between these systems needs greater exploration in terms of cross-organizational behaviors. We thus encourage organizational scholars to research long-term systemic risks that have yet to receive scholarly attention. For example, the World Economic Forum's *The Global Risks Report 2017* found that social instability, migration, and water crises are the most critical societal risks for businesses in 2017 (WEF, 2017). Amongst the top environmental risks are biodiversity loss and ecosystem collapse. However, our review of the literature shows that these risks have received little attention. We urge organizational scholars to devote more attention to these pressing global risks. In addition, future empirical research is needed to explore barriers and enablers to our collective framework, including a deeper analysis of the role of entrenched vested interests and power relations.

Finally, we argue that a cross-organizational and transdisciplinary approach is necessary. Organization scholars cannot effectively address planetary risks to and from organizations without collaborating with our natural science colleagues. We thus reiterate the long-standing call in sustainability research for greater transdisciplinary integration and closer collaboration between social scientists and natural scientists to help to fill these gaps. While it may be true that societies in the past have been catastrophically surprised by environmental risks, we argue that a transdisciplinary approach to organizational risk can help us learn from the mistakes of the past and collectively contribute to a safe space for humanity. There is no time to lose.

CHAPTER 5 SOCIAL-ECOLOGICAL SUSTAINABILITY FRAMEWORKS: COLLECTIVE ACTION FOR GLOBAL SUSTAINABILITY[4]

Abstract

Given the capacity of collective business actions to impact macro-level systems, the need for managers to understand complex social-ecological systems may be essential. Therefore, this chapter addresses the question, "How are social-ecological sustainability frameworks utilized as a systemic basis for collective strategic planning and communication in a global business association?" To answer this question, we draw on a case study spanning from 2008 until 2018 of the World Business Council for Sustainable Development, a global business association that mobilizes 200 multi-national corporations to develop sustainable solutions on the basis of two systems level frameworks. The Planetary Boundaries Framework identities the impact of human activity on nine critical Earth system processes. The United Nations Sustainable Development Goals demonstrates the complexity of interconnected economic, social, and environmental global development issues. Both frameworks furthermore stress the urgency of addressing these issues. We found that social-

[4] A different version of this article with Gail Whiteman and John Parker is currently under review.

ecological sustainability frameworks were utilized as a basis for collective strategy setting and communication. We identified eight overlapping and emerging phases during which the Planetary Boundaries Framework and the UN Sustainable Development Goals were developed and utilized in collective efforts for global sustainability. Our findings show that Planetary Boundaries Framework was an effective framework for setting collective targets for business action based on science. Furthermore, the Sustainability Development Goals framework was utilized primarily for communication and reframing current strategies.

Introduction

Human activity is driving a shift from the Holocene, a stable planetary state lasting 10,000 years, to the Anthropocene, a new geological period where humans are the dominant influence on earth systems (Steffen et al., 2007). Collective corporate action is likely a main contributor to this shift and profoundly impacts macro-level systems (Whiteman et al., 2013). The need for managers to understand the dynamics of complex social-ecological systems, interconnected systems of human and nature (Walker & Salt, 2006), may be essential to safeguarding the systems on which corporations depend and ensuring "a safe operating space for humanity" (Rockström, Steffen, Noone, A. Persson, et al., 2009: 472).

Despite scientific and political advancements to develop social-ecological sustainability frameworks (Rockström, Steffen, Noone, Å. Persson, et al., 2009; United Nations, 2018), research that examines the implications of global level systemic frameworks for corporate sustainability practices is limited. Prior research regarding sustainability practices have focused on firm or industry level and we lack empirical knowledge about the relationship between firm-level and macro-level processes (Whiteman et al., 2013). A small body of research seeks to understand the use of scientific frameworks in policy strategic planning (Clift et al., 2017), but little research exists about the implications of these advancements for corporate sustainability practices. Therefore, in this

chapter we seek to answer the following research question, "How are social-ecological sustainability frameworks utilized as a systemic basis for collective strategic planning and communication in a global business association?"

Our research question is worth pursuing given the fragility of the Earth's systems and impact of collective corporation action on macro-level systems (Whiteman et al., 2013). Most current approaches, such as life cycle analysis, "focus on reducing relative unsustainability" (Clift et al., 2017: 2). Critiques of this approach argue that sustainability is a systems based concept which only makes sense at the planetary level (Gray, 2010; Whiteman et al., 2013). Contrasting approaches to reducing relative unsustainability, social-ecological sustainability frameworks allow for conceptualization and operationalization of "absolute environmental sustainability" (Clift et al., 2017: 2).

In this chapter, we consider the utilization of social-ecological sustainability frameworks by a global business association. We draw on a case study, spanning from 2008 until 2018, of the World Business Council for Sustainable Development (WBCSD), a CEO-led not-for-profit business organization that mobilizes 200 multi-national corporations to advance sustainability. During the duration of our case, two frameworks, the Planetary Boundaries Framework (PBF) (Rockström, Steffen, Noone, A. Persson, et al., 2009; Rockström, Steffen, Noone, Å. Persson, et al., 2009; Steffen, Richardson, et al., 2015) and the United Nations (UN) Sustainable Development Goals (SDGs) (United Nations, 2018), served as a basis for strategic planning and communication. We investigate the implications of these two frameworks for the WBCSD.

In 2009, the PBF was published and provided a scientific understanding of the environmental limits which define the "safe operating space for humanity" (Rockström, Steffen, Noone, A. Persson, et al., 2009: 472; Rockström, Steffen, Noone, Å. Persson, et al., 2009; Steffen, Richardson, et al., 2015). The PBF significantly advanced our knowledge about the ecological constraints of human development. The framework indicates nine boundary processes within which offers a safe place for humanity to

develop. Furthermore, in 2012, the PBF was one input to the discussions occurring between UN national delegates and the heads of state at the Rio+20 Summit (Sharma, 2012). At this summit, leaders called for a post-2015 global development agenda to replace the Millennium Development Goals (MDGs) that would expire in 2015.

In September 2015, the SDGs replaced the MDGs as the agenda for global development until 2030. The 17 goals and 169 targets address the world's most pressing and interconnected economic, social and environmental issues. Since their adoption in September 2015, the SDGs have spread quickly as a framework to convene diverse stakeholders and establish a common language to drive action towards the 17 goals. Since Rio+20, many businesses demonstrated strong support for the agenda and were called upon to take immediate action (UNGC, 2014). Ban Ki-moon, former UN Secretary-General stated, "Business is a vital partner in achieving the Sustainable Development Goals. Companies can contribute through their core activities, and we ask companies everywhere to assess their impact, set ambitious goals and communicate transparently about the results" (GRI et al., 2015: 4). The leadership and innovative capacity of the private sector is essential for achieving the SDGs due to its impact on society and natural resources (Sachs, 2012).

Our findings begin in 2008, with the launch of WBCSD's strategy document, Vision2050. Vision2050 identifies pathways to move from "business as usual" to a sustainable world by 2050 where "9 billion people can live well" "within the limits of the planet" (WBCSD, 2013a). We show how Vision 2050 established a long-term systemic view of sustainability and laid the foundation for future strategy development. In 2012, a change in leadership occurred at WBCSD, triggering a focus on developing actionable business solutions for sustainable development. Building on Vision2050, the new leader implemented Action2020. Action2020 is a strategic platform developed on the basis of the PBF to define short-term targets for business action. We show how the PBF helped WBCSD members understand ecological systems and to develop a strategy for reducing corporate

environmental impacts within the boundaries of the planet (Whiteman et al., 2018).

In October 2010, after the launch of Vision2050, the process to develop the SDGs began. We show that UN led processes to formulate the SDGs occurred in parallel to WBCSD's strategy development. The SDGs incorporated input from the scientific and business community, a number of whom were also involved in Action2020. The WBCSD represented the voice of the business community in the post-2015 process and gave input through the Sustainable Development Solutions Network (SDSN) (Leisinger & Bakker, 2013). Furthermore, WBCSD's former Chairman, Paul Polman served on the High-Level Panel of eminent persons for the SDGs (UN Secretary-General, 2012).

Following the launch of the SDGs in September 2015, WBCSD's strategy, Action2020, was reframed to demonstrate its alignment with and contribution to the SDGs. In order to translate the SDGs into actionable business language, WBCSD collaborated with other international organizations to develop the business case for the SDGs and tools to help companies integrate the SDGs into corporate strategy. We then show how WBCSD member companies adopted the SDGs as a framework for strategic planning, reporting, and communication.

This chapter proceeds as follows: First, we introduce social-ecological systems research. Second, we present the findings of our case study beginning with a visual display of the eight phases and a timeline of key events. Then we present a chronological narrative of the eight overlapping phases. Third, we discuss the implications of the case study, limitations, and provide avenues for future research.

Social-Ecological Systems Research

Social-ecological systems are interconnected systems of human and nature (Walker & Salt, 2006), with reciprocal feedbacks, whereas human activities influence and are influenced by the dynamics of ecosystems (Chapin, Folke,

& Kofinas, 2009; Folke et al., 2010). Human systems are embedded in and depend on natural systems.

Chapter 2 reviews the literature on social-ecological systems in sustainability management research. Our literature review identified just over 20 articles that adopt the social-ecological systems perspective in management journals. Of these articles, 18 were conceptual, while only two were empirical, and one was a literature review, highlighting the need for more empirical research in this area.

These studies seek to enrich our understanding of organizational interconnectedness with social-ecological systems and global sustainability (Mahoney et al., 2009; Porter, 2006; Whiteman et al., 2013; Winn & Pogutz, 2013). An embedded view stresses systemic limits and the dependence of business, the economy, and society on nature (Marcus et al., 2010). Integrating insights from the natural sciences, to understand the embeddedness of firms in ecological systems across scales, research emphasizes the presence of feedbacks between firm-level actions and the planetary boundaries (Whiteman et al., 2013). "Organizational ecosystem embeddedness" defines a "mutual relationship of impact and dependence" to protect and manage natural systems that provide essential life-supporting services (Winn & Pogutz, 2013: 220).

Simply, when managers understand the functioning, dynamics, and feedbacks of complex social-ecological systems, the relationship between the organization and those systems are better managed (Kunz et al., 2013b). An ongoing awareness of ecological change and recognition of subtle cues from the natural environment may reduce vulnerabilities and avoid ecological surprises (King, 1995; Whiteman & Cooper, 2011). Responding quickly to ecological knowledge can prevent suddenly crossing over a threshold into a new and potentially unfavorable domain (King, 1995; Whiteman & Cooper, 2011; Whiteman et al., 2013). Identifying leverage points can indicate ways to intervene in a system and change the structure of systems towards more favorable domains (Meadows, 2009).

However, given the scale and complexity of social-ecological change, driving systemic solutions to macro-level sustainability issues requires

innovative forms of partnership and collaboration (Hodge, 2014; Mahoney et al., 2009; Nidumolu et al., 2014). Cross-scale knowledge creation and interdisciplinary action are valuable for understanding complex social-ecological interactions (Manring, 2014). For example, collaboration in the agri-food industry can create social-ecological knowledge that drives transformation towards sustainability within the organization and surrounding community (Pogutz & Winn, 2016). Research finds collaboration between scientists and corporations helps to integrate consideration for environmental costs and benefits into business decisions driving improved environmental outcomes (Kareiva, McNally, McCormick, Miller, & Ruckelshaus, 2015) and set collective targets for global sustainability based on science (Whiteman et al., 2018).

Beyond understanding the complexity of external systems and approaching social-ecological challenges in partnership, a change in managerial cognition from a reductionist to an integrative or from a neoclassical to a systemic is essential to sustainable development progress (Gladwin et al., 1995; Seiffert & Loch, 2005; Shin et al., 2008; Shrivastava et al., 2013; Stormer, 2003). Changing shared mindset, the "set of beliefs about how the world works" which determines the goals, rules, and structure that govern the system can change the feedbacks, flows and "everything else about systems" (Meadows, 2009: 162–163). However, changing shared beliefs of an entire society is challenging and progress can be slow (Meadows, 2009).

We found little research that examines the role of social-ecological sustainability frameworks in stimulating systemic thinking in corporate sustainability practices. Both the PBF and the SDGs can serve as a scientific or political basis for connecting collective firm impact to macro-level processes (Whiteman et al., 2013, 2018) and environmental management accounting (Schaltegger, 2017). Concerning the importance of the PBF for corporate sustainability reporting, research finds that reports are primarily firm-centric and lack links to boundary processes (Haffar & Searcy, 2018). Furthermore, research highlights several limitations of this practice including the complexity of accounting for indirect impacts, misleading

disclosures and incomplete information (Antonini & Larrinaga, 2017). We seek to contribute to this body of literature by demonstrating the use of global level social-ecological sustainability frameworks as a basis for corporate sustainability strategic planning and communications in a global business association.

Methods

We studied our case, WBCSD, from 2008-2018. The WBCSD is a CEO lead organization that emerged out of the discussions about the role of business in global development during the Rio UN Earth Summit in 1992. WBCSD acts as a convening power, linking corporate sustainability professions within and across industries to share knowledge and best practices.

This research was conducted in an emergent and iterative manner (Miles & Huberman, 1994; Whiteman & Cooper, 2011) based upon a "reflexive process which operates throughout every stage of the project" (Atkinson & Hammersley, 2007: 24). We maintained a flexible research approach to allow for the "unexpected" and "the exercise of judgement in context; not a matter of simply following methodological rules" (Atkinson & Hammersley, 2007: 23). This research utilizes qualitative case study research to investigate the process of cross-organizational action on the basis of social-ecological sustainability frameworks. Iterations included combinations of the following ongoing and overlapping processes: (re)formulation of the research question, data collection including interviews and observation, data analysis, respondent validation, engaging with prior literature, writing working papers, and presentation of emerging findings for academic feedback.

Insights gained in the field and the analysis of primary data drove the emerging focus of this study. As such, the case context shaped the emergence of the research process and the research question was formulated and reformulated to make it more agreeable (Atkinson & Hammersley, 2007: 37). For example, in the research proposal before entering the field in May 2014, the first co-author proposed the broad

question, “How are firms employing sustainability oriented innovation to enhance the resilience of social-ecological systems?” She formulated this question based on a review of WBCSD’s website and key documents. However, after conducting observation starting in June 2014, she observed that WBCSD is not a platform for developing innovations. The WBCSD provides a space to develop methodologies to measure sustainability performance or to discuss and identify levers to create the market conditions for sustainable products or services to thrive. She also observed that it would be very difficult to show if and how the outcomes of WBCSD’s actions enhance social-ecological resilience. This is partially due to the lack of methods and processes to link WBCSD business solutions to macro-level processes.

Our unit of analysis is the evolution of the WBCSD strategy, including consideration for its member companies and the formal and informal partnerships formed, from 2008-2018. In this chapter, we pose the research question: How are social-ecological sustainability frameworks utilized as a systemic basis for collective strategic planning and communication in a global business association? Our question is motivated by the argument that most of the sustainability management literature focuses on the firm-level of analysis (Bansal & Gao, 2006; Whiteman et al., 2013), and lacks a systemic perspective (A. Williams et al., 2017; See also Chapter 1). Our review in Chapter 2 demonstrates a paucity of empirical research about the process of collaborating for social-ecological systems level sustainability. Our case addresses this theoretical gap because WBCSD’s strategy, Action2020, mobilizes multi-national companies to actively contribute towards systems level sustainability (i.e. Action2020’s targets, which are called ‘societal must-haves’).

One could argue that WBCSD is an extreme case (Miles & Huberman, 1994: 28). WBCSD is an unusual case due to the scale of the network, the development of science-based targets and its role in international development discussions. We explain three reasons why WBCSD is an extreme case. The 200 WBCSD members represent 8.5 trillion USD in revenues and employ 19 million people (WBCSD, 2018a). Second, the

organization's approach to setting science-based targets based on the PBF is rare, making it one of few cases to examine the use of the PBF. Third, the organization has represented the voice of the business community in international policy conversations since the 1992 Earth Summit in Rio de Janeiro. Therefore, the WBCSD has not only adopted the SDG framework but also contributed to the evolution of international sustainable development discussions since the initiation of the association (Ferns & Amaeshi, 2017).

Data comes from four sources: (1) interviews, (2) documents, (3) an ethnographic study and (4) two personal accounts.

Interviews

The first co-author conducted a total of 118 interviews in three intervals. The total length of the interviews recorded amounts to almost 62 hours of recording. I conducted ethnographic interviews to encourage the interviewees to share experiences as conversations while gently guiding the conversation towards one of the three lines of inquiry (Spradley, 1979) as described in more detail below. We now describe the three intervals.

Interval 1. From March 2015 until May 2017, the first co-author conducted 55 semi-structured interviews about the history of WBCSD and the current business solutions in progress. The first co-author conducted interviews with representatives from WBCSD member companies, WBCSD staff members and representatives from international organizations, which partner with WBCSD. To understand how the WBCSD evolved over time we used the following interview protocol structure: the interviewee's story about how WBCSD has changed over the year, description of the time before and after the change in leadership and description of how the strategy has changed. To understand more about the business solutions at WBCSD we followed the same general interview structure: story of how the project evolved, identification of the key challenges/ facilitators, description of a collaborate experience that went well/ one that was a disaster, identification of critical turning points during the projects, inquiry about the aim of

WBCSD, recommendations on how to scale up future collaboration for Action2020 and key learning lessons.

Interval 2. In spring 2015, the first co-author conducted 38 semi-structured interviews regarding the formulation of Action2020. The four stakeholder groups included core scientists, key representatives from WBCSD member companies, WBCSD staff members, and individuals from international organizations[5]. We selected interviewees based on observer-identified criterion; the individual participated significantly in the formulation of Action2020 (Atkinson & Hammersley, 2007). Each interview protocol followed the same general structure: the interviewee's education and work experience, current role, involvement with Action2020, perspective on the process of developing Action2020 and key moments of Action2020 which included barriers, facilitators, and key learning points.

Table 5.1 Interview Data Summary

	Sector	**Number of Interviews**	**Total Length (HH:MM:SS)**
History and Work Programs	WBCSD Staff (WB)	25	12:53:10
	Member Company Representative (MC)	24	13:09:55
	International Organization (IO)	7	03:19:13
	Total	55	29:22:18
Action2020	WBCSD Staff	13	07:16:55
	Member Company Representative	20	10:05:24
	International Organization	2	01:14:07
	Scientist (S)	3	01:48:56
	Total	38	20:25:22
SDGs	WBCSD Staff	4	01:49:16
	Member Company Representative	11	05:04:25
	International/ Partner Organization	9	05:01:02
	Total	24	11:54:43
Overall Total		118	61:42:23

[5] Another article, currently under review, exists utilizing this interview data. Gail Whiteman is the lead researcher of the project, including three other collaborators, Amanda Williams, Steve Kennedy and John Parker entitled "Cross-Organizational Ecological Sensemaking for Collective Corporate Strategizing."

Interval 3. In spring 2017, the first co-author conducted 27 semi-structured interviews regarding business engagement with the SDGs. Interviews were conducted with representatives from WBCSD member companies, WBCSD staff members and individuals from international/ partner organizations. We selected interviewees based on observer-identified criterion; the individual represented the company or served as a contact point with regards to SDG engagement (Atkinson & Hammersley, 2007). The interview protocol covered six areas of inquiry: engagement with the MDGs, general business and firm specific engagement with the SDGs, the benefits and consequences of engagement and the drivers of change.

Documents

In spring 2015, with the aid of a research assistant, we collected 28 internal documents, including strategy documents, presentations, feedback reports, executive briefs, memos, emails, and personal notes[6]. These helped capture participants' real-time reflections about Action2020's construction and to identify the intermediary steps in its developmental process. External documents included documents available to the public relating to Action2020. We conducted archival searches to track the evolution of Vision 2050 to Action2020, and the development of the PBF. We collected 82 WBCSD and SRC annual reports, executive briefs, videos, blogs, and digital images (2009 - 2015). We also collected 17 news articles, 691 tweets concerning Action2020, and 287 tweets regarding the PBF.

In spring 2017, the first co-author collected key publically available documents pertaining to WBCSD's work on the SDGs. She began with the documents I referred to during the first author's work on the SDG Compass. She also, collected documents that informants referred to during meetings, informal conservations, and interviews. We collected 50 documents totaling 1716 pages. 20 documents were published by international organizations,

[6] Another article, currently under review, exists utilizing this interview data. Gail Whiteman is the lead researcher of the project, including three other collaborators, Amanda Williams, Steve Kennedy and John Parker entitled "Cross-Organizational Ecological Sensemaking for Collective Corporate Strategizing."

11 by businesses, 6 by the UN, 6 by collaborative efforts, 3 by scientists, 2 by a philanthropic foundation and 2 by consulting firms. The first co-author then collected 40 internal documents pertaining to WBCSD's engagement with the SDGs that are not publically available. These documents total 509 pages and include 15 newsletters, 12 meeting summaries, 5 presentations, 3 emails, 3 strategic planning documents, and 2 staff briefings.

Ethnography

The first co-author conducted ethnographic field research at WBCSD periodically from June 2014- March 2017. She spent in total, 156 days in the field, amounting to 1295 hours. She worked at the head office in Geneva, Switzerland for 109 days, while she worked outside the office at members' offices, project meetings or annual events for a total of 47 days. As an associate on the Redefining Value team at WBCSD, one of her tasks was to support the development of the SDG Compass, a guide for business action on the SDGs, from January 2015 until its release. The guide is a collaborative effort of the WBCSD, Global Reporting Initiative (GRI), and UN Global Compact (UNGC) that outlines the steps to align corporate strategy with the SDGs and provides indicators for measuring progress. Her responsibilities included project support and communications of the guide. She had minimal influence on the content of the guide. The SDG Compass launched at the UN Private Sector Forum, bringing together 206 CEOs and heads of state during the launch of the goals. Shortly after the adoption of the SDGs, discussions resurfaced about the relationship between WBCSD's collective strategy for global sustainability, Action2020, and the SDGs. In October 2015, a manager of the Redefining Value team and the first co-author led on an ongoing internal project to measure the impact of Action2020 against the SDGs. They developed a project plan to establish the internal processes for measuring and reporting on the impact of Action2020.

Personal accounts

Our final source of data is autoethnographic accounts (Ellis, Adams, & Bochner, 2010). Two co-authors wrote narrative ethnographies of their

experience at WBCSD. The second co-author participated in developing Action2020 (beginning March 2012 until current). A narrative ethnography, in the form of a story, descriptively captures the ethnographer's experiences and interactions with others in the field (Ellis et al., 2010).

Data Analysis

The first co-author conducted data analysis which comprised of both formal (such as field notes and coding) and informal (ideas and intuitions) elements (Atkinson & Hammersley, 2007: 205). Data analysis was ongoing from the "pre-fieldwork phase" and the identification of the initial research question (Atkinson & Hammersley, 2007: 205). Formal data analysis consisted of three main processes, (1) construction of a timeline, (2) coding and (3) validity checks.

Timeline

We created a timeline of WBCSD events by conducting an extensive internet search for documents (with the brief aid of a research assistant from March to July 2015). We aim was to capture events related to Action2020 and the UN SDGs. We also incorporated key events from interviews. Our timeline identifies 63 key events in total (see Table 2). We identified 27 significant meetings, 10 presentations, 4 speeches, the launch of 19 significant reports, and 36 important turning points during the development and utilization of two social-ecological sustainability frameworks. These events took place in 21 cities around the world.

Coding

Using NVivo 11 qualitative data analysis software, the first co-author coded the interviews line by line. She allowed for flexibility in the analytical strategy while attaching codes to segments of data. She retained informants 'in vivo' quotes as codes and remained close to the data. For example, an 'in vivo' code attached to the quote "So if you really then say the SDGs as leading for the agenda for society, for long-term value creation and if you as a company are aspiring to generate long-term value creation" was 'long-term value creation.' Examples of other 'in vivo' codes include 'business can

contribute,' 'risk agenda' and 'long-term value creation.' If a segment of data represented an extant concept in the literature, I coded that segment of data accordingly. However, when a segment of data represented an extant concept in the literature, the segment of data was coded accordingly. This allowed for connections with extant theory to be triggered by the data (Loftland, Snow, Anderson, & Loftland, 2006). Several bodies of literature including interorganizational collaboration, corporate sustainability, systems thinking, resilience theory, social-ecological systems theory acted as resources to understand the data but were not forced onto the data (Atkinson & Hammersley, 2007: 210). She treated codes provisionally and often renamed them to fit the data. For example, a code 'success of the SDGs depends on broad participation' was renamed to 'success of the SDGs depends on involving diverse stakeholders' to reflect the language used by the informants.

Validity checks

To ensure the quality of our data we leverage data from multiple sources including interviews, documents, and personal accounts. To ensure the validity of our findings, we used respondent validation (Locke & Velamuri, 2008). In June 2015, two key informants reviewed our timeline of events, one WBCSD staff member, and one member company representative. In December 2017, we arranged a follow-up interview with three key informants, two member company representatives and one WBCSD staff member, to discuss member companies' engagement with the SDGs. Modifications were made based on the feedback provided by the key informants.

Data Integrity

This study was part of the Marie Curie Initial Training Network, Innovation for Sustainability (I4S). On January 4, 2012, the second co-author obtained a formal letter of commitment, signed by the incoming President of WBCSD, to participate as an industry partner in the I4S network. This letter established a collaboration between RSM and WBCSD to hire and train an early career researcher. Under the terms of this letter, the early career

researcher from RSM, could conduct qualitative research at the WBCSD and participate in network events upon the establishment of a formal secondment agreement.

The WBCSD and RSM established a formal secondment agreement allowing the first co-author to work as an associate on the Redefining Value team for one year from August 2015. The work description of the agreement called for a PhD level internship to aid the development of the SDG Compass. Furthermore, it required the secondee to collect and analyze qualitative data and to disseminate research findings.

At the beginning of each interview, the interviewer received verbal permission to record the interview, explained the purpose of the research, the data collection procedures and the intended output. Interviewees were informed about the anonymity of their name, title, and organization. Interviewees could request to view and approve interview transcripts and to view any direct anonymous direct quotes.

Findings

We display the findings in sequential phases (see Figure 5.1 for a visual of the phases). Phases directly related to the work of WBCSD are numbered Phase 1-4. Phase 2 is an umbrella phase that comprises three sub-processes that contribute to WBCSD's ambition to drive action. Phases related to the development of the SDGs led by the United Nations are lettered phase A-D to distinguish them from the phases led by WBCSD.

Our analysis shows that in Phase 1, WBCSD developed a long-term systemic view of sustainability known as *Vision2050*. The end of a leadership term at WBCSD and arrival of a new leader trigged the focus of the network to shift from aspiration to driving action (Phase 2). Peter Bakker, the new CEO of WBCSD, started in January 2012 and in his first 100 days (Phase 2a) established a plan for driving action. The development of Action2020, a collective strategy for sustainability began during an annual WBCSD member meeting in April 2012 (Phase 2b).

Our analysis shows that WBCSD's strategy development co-evolved with international policy discussions. Commencing during the development of Vision 2050, discussions at the UN triggered the development of the post-2015 agenda (Phase A), followed by business and science input to the post-2015 process (Phase B&C). In September 2015, the SDGs launched (Phase D) and then the WBSCSD and others translated the SDGs for businesses (Phase 3). Action2020 was then reframed to demonstrate alignment with and contribution to the SDGs (Phase 2c) and member companies adopted the framework in corporate reporting, communications and strategy setting (Phase 4).

Figure 5.1 Phases of Collective Action for Global Sustainability

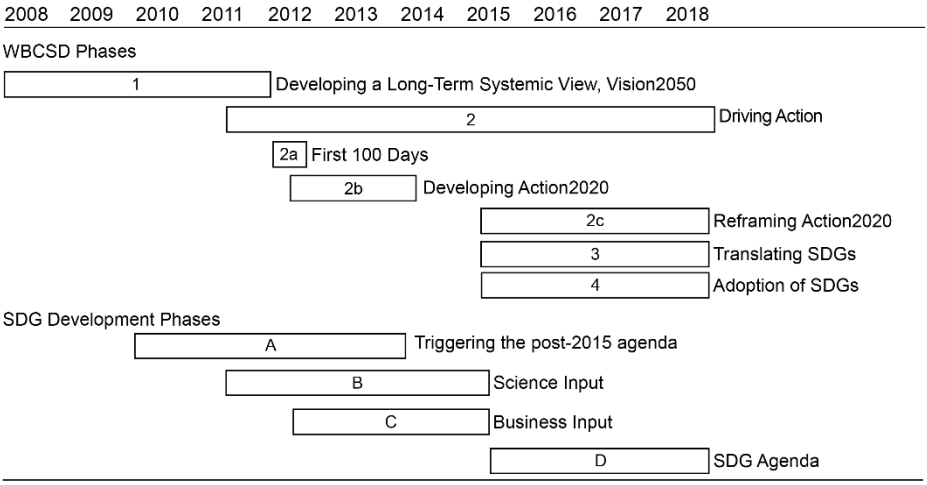


Table 5.2 is a detailed timeline of the key events related to the eight phases we identify. We mark the beginning of each phase in the timeline. For example, we indicate the beginning of Phase 1 with the '1' symbol.

Table 5.2 Events Timeline

2008	**1** Begin development of Vision2050
2009	Final Vision2050 Workshop, *Zurich*. WBCSD Council Member & Liaison Delegate Meeting: Support for Vision2050, *Johannesburg*. Earth system scientists publish PB framework in peer reviewed journals *Nature* and *Ecology & Society*.
2010	Launch of Vision2050 at Liaison Delegate Meeting, *Montreux*. Rockström presents PB framework on TEDtalks. **A** High-level Plenary Meeting of the General Assembly on the MDGs requests the Secretary-General to initiate the post-2015 development agenda, *New York*.
2011	Second co-author introduces Bakker to the PB framework, *Rotterdam*. Establishment of the UN System Task Team, *New York*. **B** Ban Ki-moon urges in a Climate Change Leaders Dialogue to defend the science and the planetary boundaries, *Cancun*.
2012	**2 2a** Change in WBCSD leadership, Bakker's first days in office. UN High-Level Panel releases Resilient People, Resilient Planet report which endorses PB framework. Bakker invites Rockström to be the keynote at WBCSD member meeting, *Montreux*. UN Secretary-General Ban Ki-moon endorses PB framework to the UN General Assembly. WBCSD's new report, Changing Pace, refers to the PBF; uses UN High-Level Panel's report as precedent. **2b** WBCSD Liaison Delegate Meeting: Release of Changing Pace with reference to the PBF. Rio +20: PB framework receives criticism leading WBCSD members to also question its legitimacy; Bakker speaks about global sustainability and the need for radical action, he is disappointed by the political outcome furthering his commitment to change; UN High-Level Panel on Climate Change endorses PB framework providing justification for use in forming Action2020. UN Task Team publishes Rio+20 outcome document, *Future We Want for All, New York*. **C** Launch of High-Level Panel of Eminent Persons including Paul Polman, former Chairman of the WBCSD, *New York*. WBCSD and SRC sign a Memorandum-of-Understanding on use of PB framework. WBCSD Council Member Meeting: Ban Ki-moon speaks at plenary, SRC scientists present, *Seoul*. 'Superstorm Sandy', *New York*. Rockström, Bakker, and Marton-Lefèvre (IUCN Director General) write a blog post calling PB framework 'the KPIs for the planet'.

2013 WEF Annual Meeting: Bakker and WRI meet to discuss partnership; Rockström speaks about PB framework, which takes centre stage, *Davos.*

The Guardian Podcast on PB framework and sustainable business.

Public announcement of Action2020 strategy.

Leisinger and Bakker publish *The Key Challenges to 2030/2050: Mapping Out Long-Term Pathways to Sustainability and Highlighting Solutions That Should be Scaled Up,* a background paper for the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda.

UN Open Working Group was established, and hereafter held 13 sessions to prepare the proposal for the SDGs.

Rockström and Sachs publish *Sustainable Development and Planetary Boundaries*, a background paper for the UN High-Level Panel of Eminent Persons on the Post-2015 Development Agenda.

SDSN Leadership Council Meeting: SDSN refers to PB framework within proposed Sustainable Development Goals; Bakker and Rockström speak at the meeting, *New York.*

WBCSD Liaison Delegate Meeting: Focus is From Vision 2050 to Action2020; Member companies push back on the use of PB framework; WRI partnership is discussed; Rockström, scientists and CEO co-chair speak at the opening; WBCSD director of Action2020 resigns, *Montreux.*

Climate and Energy Working Group Meeting: Debate about the scientific input to Action2020 continues; van Ypersele of the IPCC presents, *Brussels.*

SDSN publishes An Action Agenda for Sustainable Development calling for growth within PB framework.

Change in Action2020 Leadership in May, then again in July.

Heads of State outline the process for developing SDGs in 2015 at the UNGC Leader's Summit, WBCSD provides input via SDSN, launch of *Architects of a Better World, New York.*

IPCC publishes 5th Assessment Report WG1 The Physical Sciences Basis.

WBCSD Council Member Meeting: Launch of Action2020; CEOs attend learning lunch with Rockström; Dr. Pachuari, head of IPCC, gives a presentation to WBCSD CEOs and members, Paul Polman appointed chair of WBCSD replacing Chad Holiday, *Istanbul.*

WBCSD Executive Board Meeting: Presentation of the PB to CEOs, *London.*

Launch of the CEO Action2020 roundtables, *U.S.*

2014 WEF Annual Meeting: WBCSD launches Action2020, *Davos.*

WBCSD Liaison Delegate Meeting, *Montreux.*

Rockström and Sukhdev published *From MDGs to SDGs: Transition to a Development Paradigm of Human Prosperity within a Safe Operating Space on Earth* as an input to the UN open working group for the post-2015 development agenda.

WBCSD hosts first Low Carbon Technology Partnership initiative (LCTPi) business solutions roundtable, *DC.*

UN Open Working Group submits proposal to the UN General Assembly for the SDGs suggesting 17 goals and 169 targets, *New York.*

WBCSD Council Member Meeting, SDG Compass announced, *Atlanta.*

First SDG Compass virtual consultation with WBCSD members.

SRC and SDSN launch the MOOC PB and Human Opportunities.

IPCC publishes 5th Assessment Synthesis Report.
COP20: WBCSD and SDSN announce LCTPi roundtables, *Lima.*

2015 SRC publishes update of the PB framework in peer reviewed journal *Science.*
3 WBCSD begins collaboration with the UN Global Compact and GRI to develop the SDG Compass.
Rockström speaks at PB press conference and SDG Compass business consultation at the WEF annual meeting, *Davos.*
Bakker speaks at Green Business Summit about science-based targets, *Phoenix.*
WBCSD Liaison Delegate Meeting, *Montreux.*
WBCSD hosts second LCTPi business solutions roundtable, *Paris.*
D 4 UN SDGs are agreed upon at the UN Sustainable Development Summit by 196 countries, launch of the SDG Compass, *New York.*
WBCSD hosts third LCTPi business solutions roundtable, *India.*
WBCSD Council Member Meeting in conjunction with COP21 and forth LCTPi business solutions roundtable, *Paris.*

2016 Internal restructuring, the SDG Compass work is moved to the Social Impact Cluster, *Geneva.*
Launch of the Business and Sustainable Development Commission at the WEF, *Davos.*
WBCSD Liaison Delegate Meeting, themed *From Ambition to Implementation* focusing on the SDGs as a framework for action, *Montreux.*
UN General Assembly High-Level Thematic Debate on Achieving the SDGs, Bakker and member company executives contribute to debates, *New York.*
Signing of the Paris Agreement, Earth Day, *New York.*
WBCSD Partnership with the EAT Forum Announced, Bakker appointed to the advisory board, Rockström appointed to the board of trustees and advisory board, *Stockholm.*
WBCSD Council Member Meeting, Launch of the 2016 edition of *Reporting Matters* which concludes SDGs matter to members, *Chennai.*
WBCSD appoints a Director and Manager of the SDGs, *Geneva.*

2017 BSDC launches *Better Business, Better World* report to coincide with WEF in Davos and the US Presidential inauguration, *London.*
WBCSD Liaison Delegate Meeting, Launch of the CEO Guide to the SDGs, *Montreux.*
Second annual Business Forum and the UN High-Level Political Forum on Sustainable Development, *New York.*
WBCSD Council Member Meeting focuses on building roadmaps for the SDGs, appointment of Sunny Verghese, CEO Olam, as Chairman from 2018, *Mexico City.*
Joint call to update the SDG Compass Inventory.

2018 WBCSD Liaison Delegate Meeting, Launch of the SDG Sector Roadmaps, *Montreux.*

WBCSD Phase 1: Developing a Long-term Systemic View, Vision 2050

In 2008, Bjorn Stigson, President of the WBCSD since its inception in 1995 until his retirement in late 2011, began development of Vision 2050. The objective of Vision 2050 was to develop a roadmap and business agenda to allow 9 billion people to live well "within the limits of the planet" (WBCSD, 2013b). Over an 18-month period, 29 member companies from 14 different industries developed Vision 2050. Vision2050 was a member driven project and WBCSD provided support as the project director (WBCSD *Vision 2050* Project – Fundamentals).

WBCSD convened four Vision2050 workshops around the world from June 2008 until June 2009 (WBCSD *Vision 2050* Project – Fundamentals). During this period, the core team engaged with over 200 companies and experts (Vision2050 Key Messages). The first workshop in the UK focused on challenges of sustaining humanity on a planet with two-thirds of ecosystems facing degradation and unsustainable use (Millennium Ecosystem Assessment). The second and third workshop in the US and India focused on pathways and solutions. The final workshop in Switzerland focused on the role of business in achieving a sustainable world by 2050. The intention was to utilize Vision2050 as the basis for strategic planning for WBCSD including its member companies and as a platform for cross-sector dialogue (WBCSD *Vision 2050* Project – Fundamentals).

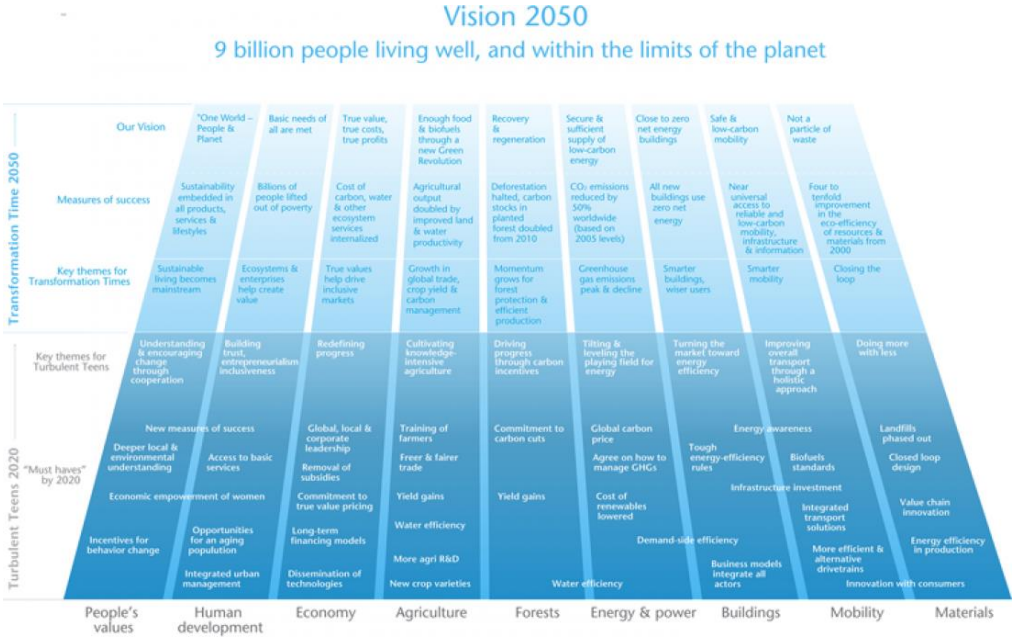
In October 2009, Vision 2050 was launched at the annual Council Member meeting held in Washington D.C. (See Figure 2). The report "outlines a pathway to reach a sustainable global society by 2050, in which the earth's 9 billion people live well and within the limits of the planet" (Vision 2050 Key Messages, p.1). The result was seen as an opportunity for companies to be part of the radical transformation required for a sustainable world by 2050, as stated in the key messages:

> "Investment in infrastructure, technology and human services driven by sustainability and resource efficiency could reach US$ 3-10 trillion per annum in 2050, creating new opportunities for business to thrive and grow." (Vision 2050 Key Messages, p.1).

One member of WBCSD's staff members recalled Vison2050 speaking to the opportunity for companies outlined in the document:

> "When we look at this transformation that society will have to go through, we see from global, that this is the biggest business opportunity that we have ever seen as global companies in the history of industry. Enormous potential for those that get it and understand what the benefits could be. And those that don't get it they won't be around by 2050." (WB17)

Figure 5.2 Vision2050 Pathways



Source: (WBCSD, 2013b)

The shared vision of sustainability for business by 2050 laid the foundation for WBCSD's subsequent strategic planning and work streams. Under the leadership of Stigson, the role of business in international debates regarding sustainable development had progressed significantly. When discussions of the council began in 1990, "business didn't have a seat at the table" and

was seen as an outsider (WB17). By the Johannesburg Earth Summit in 2002, business was seen as a "respected player" (WB17).

Although business was now a well-respected contributor to the global sustainability dialogue and seen as a partner (Ferns & Amaeshi, 2017), the council was in a moment of inertia and stagnation towards the end of Bjorn's presidency. In terms of outputs produced by the council, WBCSD reached a point where nothing radically new was happening. Or as one interviewee described, the organization was "nearly dead" (WB12). Interviewees expressed that the organization was still surviving but due to a lack of fresh output, was regarded as less relevant in the sustainability space. Furthermore, according to interviewees, the reports were not receiving the same level of attention as the earlier reports. Vision2050 received much attention from the members and was an exception to the otherwise less significant outputs. A representative from one of the member companies commented on his prior organization's involvement around the time Stigson retired:

> "I stopped the relationship between [our organization] and the WBCSD because it just wasn't productive. There was nothing, well nothing was coming out of it. And it was just too hard work to get things done. So I think at that stage, it was quite a negative, at least from an NGO world perspective, it was quite a negative view of WBCSD as an organization which brought together companies to talk about things but didn't really do anything." (MC33)

The waning relevance of WBCSD's output was also in part due to the evolution of corporate sustainability since the inception of the network. When WBCSD first emerged, sustainability was relatively new for the business community. The council spent much time building awareness about sustainability issues. As sustainability became more of a mainstream topic for businesses, building awareness of issues became less and less relevant. One WBCSD member commented:

> "The first 15 or so years of WBCSD were focused around awareness raising. I think everybody knows about the issues

> now. It is about what do we do about the issues, the focus changed from, from reports to action." (WB24)

The competitive landscape matured since WBCSD was founded in 1995. Other organizations began to emerge and to create space for sustainability conversations in the business community. Therefore, interviewees felt WBCSD was losing its unique selling point as competition continued to increase. When WBCSD first started, it was the only platform for conversations about sustainable development for business, but as time progressed, other organizations began to compete in this space. A WBCSD staff member commented on the increasing competition:

> "And so competition started to impact [the WBCSD] and it continues to impact now. So for many years, it was only WBCSD. And then at the end of year 2010 more institutions were looking at this. And as a consequence, the companies had different avenues for which they could engage in climate change, not only through WBCSD. So in some ways we lost a bit the monopoly that we had. Not because there was a monopoly, but because we were the only ones in town that were doing this." (WB29)

As a result, interviewees expressed that during this period, the council needed fresh ideas and a new direction. Many staff and member company representatives recognized it was time to change and expressed that they were ready for change. One WBCSD staff member noted:

> "Definitely [WBCSD] needed fresh ideas, fresh direction, we were stagnating a bit, we were keeping up with the global trends, making companies aware of trends, advocacy, policy, but it needed very much a shift." (WB22)

Similarly, a member company representative recounted:

> "Because Bjorn had been there for so long, and, you know, it did feel that it was time for change. And I think everybody kind of didn't deny that you know, change was needed. And even though everybody liked Bjorn a lot, it was just, you know, it is time for change." (MC40)

SDG Development Phase A: Triggering the post-2015 agenda

In October 2010, one year after the launch of Vision2050, the High-Level Plenary Meeting of the General Assembly on the MDGs requested the UN Secretary-General to instigate the post-2015 development process. Following this meeting, in September 2011, a UN System Task Team was established to support the process.

Nearly a year later, in June 2012, at the UN Conference on Sustainable Development, the Rio+20 Summit, countries committed to developing a post-2015. *The 'zero draft'* presented at Rio+20 acknowledged the planetary boundaries concept and the carrying capacity of the Earth's systems (Sharma, 2012). The outcome document Rio+20, the *Future We Want*, established an inclusive process to develop the goals. Henceforth, the SDGs were to be developed through an open process allowing for input from all sectors of society. The UN invited businesses, international organizations, trade associations and citizens to participate in open consultations during the development of the goals.

In June 2012, following RIO+20, the UN System Task Team published the report *Realizing the Future We Want for All* for the Secretary-General. The report called for "more holistic approach" for addressing "highly interdependent" development challenges (UN System Task Team, 2012: i).

SDG Development Phase B: Science Input to the SDG Process

In this section, we describe how input from the PBF shaped the SDG agenda. In September 2011, UN Secretary-General Ban Ki-moon urged during a speech to the Leader's Dialogue on Climate Change, "Help us defend the science that shows we are destabilizing our climate and stretching planetary boundaries to a perilous degree" (Akena, 2011). As noted on SRC's website, "Centre researchers kept planetary boundaries in the forefront of policy-advisory processes leading up to the agreement of the global Sustainable Development Goals" (Stockholm Resilience Centre, 2018).

Published in March 2013, Jeffery Sachs, the Director of SDSN and special advisor to Ban Ki-moon on the MDGs, and Johan Rockström drafted a document for the High-Level Panel discussions, *Sustainable Development*

and Planetary Boundaries. The report highlighted the challenges of human development on a finite planet and leveraged the PBF to describe "global environmental constraints" (Rockström & Sachs, 2013: 2).

In April 2014, Johan Rockström and Pavan Sukhdev released an input document to the 11th session of the open working group for the post-2015 agenda (Rockström & Sukhdev, 2014). The report stressed that human action is now a driving force of change on a global level and that "growth must occur within planetary boundaries" (Rockström & Sukhdev, 2014: 1).

WBCSD Phase 2a: First 100 Days

In mid-2011, the WBCSD ExCo[7] was searching for the next president of WBCSD. Bjorn Stigson would soon retire and step down as president of the WBCSD. The ExCo and the Chairman, Paul Polman, CEO of Unilever, contacted Peter Bakker as a potential replacement for Stigson. Polman and Bakker were both Dutch CEOs and met annually at the WEF. Bakker had recently stepped down as CEO of a Dutch multi-national transport and logistics company, TNT. He was lauded for establishing TNT as a leader in corporate sustainability, for establishing an innovative partnership with the UN World Food Program and for setting ambitious emission reduction targets (WBCSD, 2012a). Bakker expressed his decision to leave TNT in an interview:

> "I have the rule in my life that when you are asked to lead something you should disappear after 10 years. Because then it gets all too comfortable and then the organization becomes you rather than you serving the organization. So, when I reached my 10 year point and we demerged the company and I was offered to be the CEO of one of the parts but I said no, 10 years is enough. I am going to do something else."

During a phone conversation with the ExCo, Bakker proposed how WBCSD should change to become "a relevant player in the space of sustainability" (Bakker, Personal Communication). In an interview, he

[7] ExCo is the term used to describe WBCSD's board members

recognized that the world of corporate sustainability had "gone through a long journey" since the formation of the council and that the council would need to change for "things to become relevant." Bakker argued that sustainability had evolved since the formation of WBCSD and the council should move from creating awareness to driving action (Bakker, Personal Communication).

In fall 2011, Peter Bakker had a meeting in Rotterdam with the second co-author for scientific advice on scaling up business solutions for sustainability (Personal Account) (Whiteman et al., 2018). The second co-author introduced the PBF to Bakker and he immediately framed is as a "dashboard" for collectively managing the Earth's scarce resources. He said it could help set targets for business action at a global scale. Bakker appointed her as WBCSD's first 'Professor-in-Residence' just shortly after he took office. He asked her to introduce the PBF to the WBCSD at the next meeting with all the member companies, which was also Bakker's first meeting with the members. These events led to the next phase, developing Action 2020 based on the PBF.

In January 2012, during the early discussions about the post-2015 agenda, Bakker began as President and CEO of the WBCSD. From the beginning, Bakker had a vision to transform the council from a platform for dialogue to driving change. He presented his plan for the ExCo on January 25, 2012. His plan included developing actionable business solutions and a work stream dedicated to the "revolution of capitalism" (now called Redefining Value) (Bakker, Personal Communication). He soon began the implementation of Action2020, an ambitious program to develop actionable business solutions based on scientific evidence.

Following the change in leadership at WBCSD, during the gestation of Action2020, the staff members faced a period of hardship related to organizational change. In addition to changing the strategy, Bakker made additional organizational changes including the physical office location, letting go of staff members, the organizational structure and governance. Whereas the years prior to the change in leadership could be described by some members and staff as "stagnating" (WB22) the period following the

change in leadership were perceived as "tense" and "difficult at times" (WB29). One WBCSD staff member recalls the changes in staff:

> "[Bakker] started January 2012 and but afterwards but after the first 6 months that is when the changes came, the beginning of the changes came mainly in staff, were um, a good number were actually laid off. Or some that decided to leave because they felt they didn't have a place there anymore. And that was quite brutal actually." (WB22)

A number of important enabling events occurred before the announcement of the formal partnership between WBCSD and SRC to develop Action2020. Vision 2050 laid the foundation for Action2020. It was perceived as a "seminal" report (WB24) and a "helpful piece of work" (MC14) which provided a good "starting point" (WB5). However, many WBCSD staff members and member company representatives expressed that it was "pretty high level and aspirational" (MC16) and that "2050 is too far out for our business planning" (MC16). Developing Vision 2050 required many resources and staff members were reluctant to "reinvent the wheel" (WB1). Therefore, Action2020 was born to move from a long-term aspirational vision to a strategy that was actionable for business. Member companies saw 2020 as timeframe more compatible with corporate strategy setting. Thus, Vision 2050 functioned as the basis for developing Action2020. Internal documents motivated the Action2020 project:

> "But for Vision 2050 to retain cutting-edge relevance it needs to keep abreast of evolving science and unfolding realities. It also needs to be translated from "thought leadership" to targeted action and impact." (WBCSD Internal Document, 2012)

> "The challenge that Action 2020 addresses is that the Vision 2050 pathway has a very large number of "Must Haves by 2020". These need to be more coherent, targeted at business in actionable and investable ways, and better informed by expert understanding of global sustainability." (WBCSD Internal Document, 2013)

In 2009, the PBF framework was published in the scientific journals *Nature* and *Ecology & Society.* 28 scientists "identified and quantified the first set of nine planetary boundaries within which human can continue to develop and thrive for generations to come" (Stockholm Resilience Centre, 2018). Crossing the planetary boundaries "may be deleterious or even catastrophic due to the risk of crossing thresholds that will trigger non-linear, abrupt environmental change within continental- to planetary-scale systems" (Rockström, Steffen, Noone, Å. Persson, et al., 2009: 1). The PBF gained credibility through events such as TED Talks by Rockström's, acceptance by the UN High-Level Panel on Climate Change (2012) and endorsement by Ban Ki-moon, former UN Secretary-General. The PBF diffused into discussions about international environmental governance severing as an integrated framework of global environmental challenges (Galaz, Biermann, Folke, Nilsson, & Olsson, 2012). However, the framework was criticized for its ability to be used as a basis in political deliberations (Lewis, 2012).

WBCSD Phase 2b: Developing Action 2020

Just prior to the Rio+20 summit, in April 2012, at the annual Liaison Delegate (LD)[8] Meeting in Montreux, Rockström presented the PBF during a keynote speech. Interviewees expressed that his speech triggered much debate and discussion amongst the corporate members. *Changing Pace* was released during the same liaison delegate meeting (WBCSD, 2012b). The report was the first published by WBCSD to recognize the PBF (WBCSD, 2012b: 35; 62). *Changing Pace* urged:

> "WBCSD has decided to issue two further pieces of work that are aimed to move Vision 2050 from an aspirational concept, to a clear and implementable call to action. This document: Changing Pace, translates each of the nine elements of the pathway to the sustainable world of Vision 2050, by means of clear and concrete public policy recommendations. This document will be complemented by a collection of concrete

[8] Liaison Delegates (LDs) are sustainability professionals selected to represent their respective company's relationship with the WBCSD

> and measurable commitments to actions by some of the largest companies on our planet." (WBCSD, 2012b: 1)

During September 2012, at the IUCN World Conservation Congress in Jeju, WBCSD and SRC signed a memorandum of understanding establishing a partnership to develop a business strategy based on sustainability science (Bakker & Rockström, 2012). In January 2014, Action2020 was launched at the World Economic Forum in Davos. The strategy defined nine priority actions, based on insights from the PBF, for business to take action. Each of the nine priority areas includes a set of 'societal must-haves' including science-based targets to meet by 2020. To achieve the societal must-haves, business solutions were developed that are 'impactful, measurable, scalable, replicable and beyond business-as-usual' (Action2020, 2015). For a detailed account of developing Action2020 see (Whiteman et al., 2018). We now summarize the process.

Conflict arose questioning the credibility of the PBF. First, regarding the accuracy of the framework, one member company representative said:

> "So I think there was some questioning of some bits of science and 'Why this and not that?'… You know …they have made a choice to simplify the science in a way that I know some scientists object to. They are saying there are lines here you cannot cross whereas in reality, it is more complex."(MC14)

Other member company representatives denounced the framework due to incorrectly understanding the representation of the scientists involved in developing it. One WBCSD staff member expressed these concerns:

> "[…] we were also getting pushback from [member companies] saying 'this is a Stockholm framework […] this is a European framework,' and of course, that is not the case, planetary boundaries is more broadly based."(WB11)

Another criticism of the framework was that it did not adequately address the social dimension of sustainability and "clearly a similar framework didn't exist" (WB5) for the social science. Determining targets

for the social areas was therefore seen as "tricky" (WB5). As one member company representative said:

> "[There was] a lot of discussions related to the social area. Because the social area was different to the natural capital. It was not so clear, natural capital has been a lot of work done and also even commitments. It is a little bit different than the social one. So there was a lot of discussion relating to this social one."(MC3)

In order to address the member company representatives' concerns regarding the credibility of the framework, SRC prepared a document detailing the network of scientists that were involved in the creation of the PBF and the center's broader international network including over 800 scientists.

Another organization, the World Resources Institute (WRI), joined as a partner to develop Action2020. WRI is a global organization operating in over 50 companies to develop research based solutions for sustainability (WRI, 2018). WBCSD successfully collaborated with the WRI in the past on projects including the Greenhouse Gas Protocol. WBCSD invited WRI to join Action2020 in order to enhance the legitimacy of the project while providing additional resources and support to justify the credibility and use of the PBF. As one WBCSD staff member commented:

> "I think working with WRI was particularly useful because they have an additional layer of credibility for us, we are not just business we also have you know a kind of impartial science-based NGO alongside us" (WB4).

In addition to questioning the credibility of the framework, one industry sector reacted strongly to terms used in the PBF. The chemicals cluster did not agree with the terms "pollution" and "release" of the PBF and the companies responded in a "defensive way" and were "relatively unhappy" (WB4). One WBCSD staff member said that "there was a lot of controversy in the exposure to harmful substances work" (WB4).

The Water Cluster challenged the spatial scale of the PBF which frames water as a global issue. They argued that water scarcity is instead a local issue and that a "planetary boundary in water doesn't make sense" (WB3). A representative from a partner organization commented on the effectiveness of the PBF in formulating Action2020:

> "I think that [the PBF] was helpful. It also wasn't perfect. So, for example, there aren't planetary boundaries for things like water, some issues are very issues are global in scale, like climate change for example its and it's much easier to talk to planetary boundary, other issues are global in the sense that they are a problem in many parts of the world like water scarcity for example, but the specifics of those challenges like water scarcity are actually very very local In terms of where the challenges are" (IO4).

Furthermore, the Water Cluster disagreed with the urgency given to freshwater scarcity. The PBF depicts that "we are in the safe space of water" (WB3), suggesting that water is not an urgent issue. However, the Water Cluster argued for water to remain a priority area for Action2020.

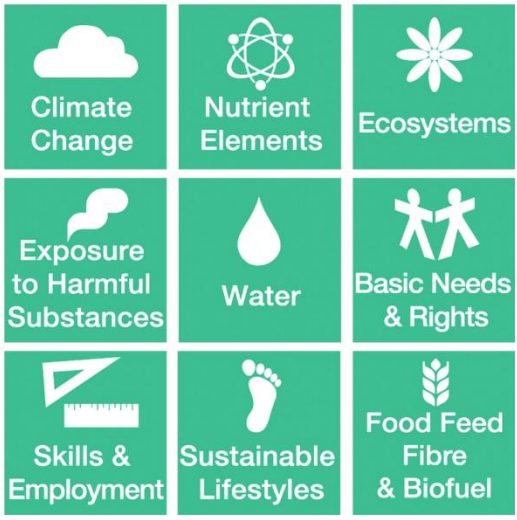
Overall, the process of developing Action2020 was perceived as "very complex process" (WB1), "very tense" (WB3), "quite contentious" (MC16) and "an intense period of debate and no small amount of disagreement" (MC11). Other tensions included conflicting professional values, time pressure and Action2020 project director turnover (Whiteman et al., 2018).

Leading up to the council meeting in Istanbul in November 2013, Bakker hosted a series of round tables around the world with Chief Executive Officers of the member companies to gain support prior to the formal approval. Then Action2020 was approved and launched for the members at the council meeting. Action2020 was publicly launched at the 2015 WEF Annual Meeting in Davos.

Developing Action2020 spanned over 18 months of collaboration between the WBCSD staff, member company representations and the SRC including an extended network of internationally renowned scientists. The resulting strategy (Action2020, 2015) acknowledged 9 priority areas for business action including climate change, release of nutrient elements,

ecosystems, exposure to harmful substances, water, basic needs & rights, skills & employment, sustainable lifestyles and food, feed, fibre & biofuels. Each of the 9 priority areas consists of societal must-haves based on scientific review. Societal must-haves are goals for businesses, governments, and society to meet together. The must-haves for the environmental priority areas were developed in collaboration with the SRC and informed by the PBF. While the must-haves for the social priority areas were informed by the emerging SDGs in collaboration with the Sustainable Development Solutions Network (SDSN). Business solutions are actionable tools to work towards the societal must-haves. As of spring 2016, the member companies developed 35 business solutions aimed at achieving Action2020. See Figure 3 for a graphical representation of the Action2020 strategy.

Figure 5.3 Action2020 Priority Areas



Source: (Action2020, 2015)

SDG Development Phase C: Business Input to the SDG Process

We now describe how the WBCSD contributed to the development of the SDGs. In July 2012, the Secretary-General launched a High-Level Panel of Eminent Persons to provide recommendations. The panel included

representatives from all societal sectors. The Chairman of the WBCSD at the time, Paul Polman, CEO of Unilever, served on the panel representing the private sector (UN Secretary-General, 2012). Furthermore, Unilever coordinated the *Sustainable Development Goals and the Post-2015 Agenda: Business Manifesto* (Unilever, 2014b) which gathered feedback from 20 leading multi-national companies about the post-2015 agenda.

In January 2013, Peter Bakker and Klaus Leisinger, the Chairman of the Novartis Foundation, released a report by means of the SDSN for the High-Level Panel discussions. The draft stressed that business "will play a role" in addressing the sustainable development challenges of the Planet (Leisinger & Bakker, 2013: 1). Vision 2050 was referenced in the document as the pathway for business to contribute to "transitions towards a sustainable economy" (Leisinger & Bakker, 2013: 1).

In September 2013, the UNGC released a report including inputs from GRI and WBCSD, *Architects of a Better World: Building the Post-2015 Business Engagement Architecture* (UNGC, GRI, & WBCSD, 2013). The report launched at the UN Global Compact Leader's Summit in New York by Ban Ki-moon, the UN Secretary-General. The report offered an implementation architecture to solidify the private sectors' role in achieving the global goals.

SDG Development Phase D: SDG Agenda

On September 25th, 2015, over 150 world leaders gathered at the UN Sustainable Development Summit in New York to launch the SDGs as the new agenda driving global development for the next 15 years (UNDP, 2015). The SDGs set an unprecedented agenda to transform the world by 2030. This agenda is highly ambitious and complex, consisting of 17 goals, 169 targets, and over 300 indicators. The goals focus on interconnected economic, social and environmental issues such as poverty, health, food security, education, climate change and the degradation of ecosystems. The agenda explicitly calls on businesses to contribute by aligning core activities, investments and innovations with the goals (GRI et al., 2015).

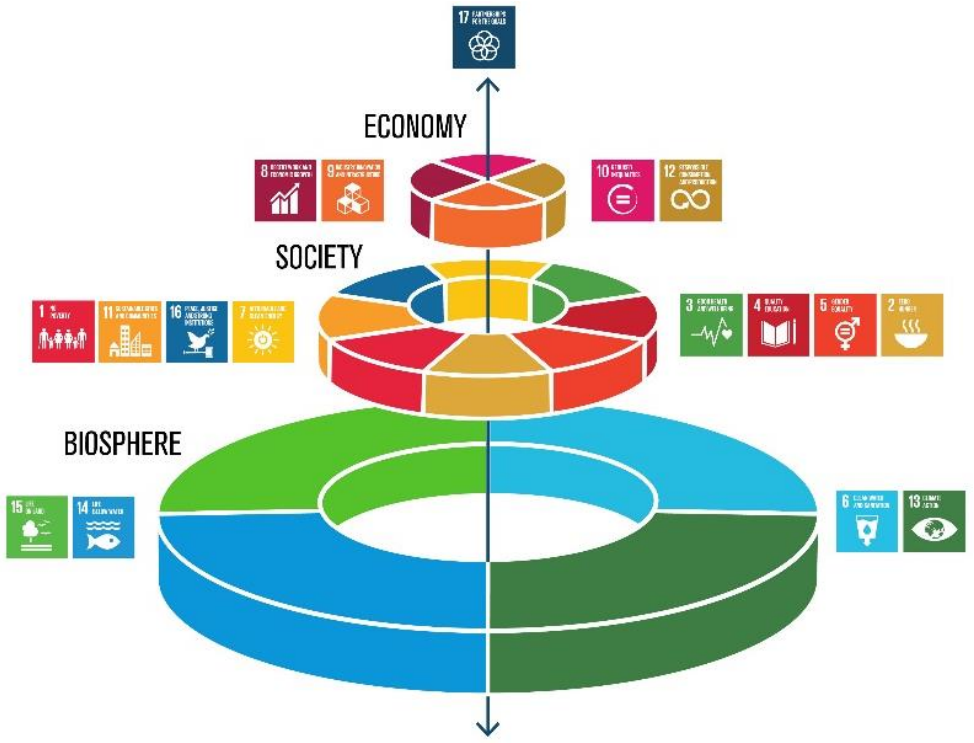
The resulting goals provide a holistic framework accounting for the rapidly increasing impact of humans on social-ecological systems and the

systemic barriers to sustainable development (ICSU & ISSC, 2015; SDSN, 2015). The UN Secretary General's progress report (UN General Assembly, 2010: 13) stressed that the SDGs are a long-term agenda which recognizes systemic limits to growth and aims to alleviate poverty before crossing critical planetary boundaries. Rockström and Bakker (2015) wrote a blog post *We Have a Plan for our Planet* and noted that the SDGs were a "significant shift in thinking from the past" because it is a universal agenda which recognizes interconnected economic, social and environmental issues and the need to solve "systemic problems." Several scientific studies seek to analyze how the SDGs interact across goal, target and indicators levels to provide a basis for policy decision making and implementation (ICSU & ISSC, 2015; Nilsson, Griggs, & Visbeck, 2016; Pradhan, Costa, Rybski, Lucht, & Kropp, 2017; Weitz, Carlsen, Nilsson, & Skånberg, 2017).

The framework has received criticism for its underrepresentation of ecosystem health (Reid et al., 2017), limitations of effective top-down intergovernmental efforts (Hajer et al., 2015), lack of "clear goals or effective guidance" (Bengtsson, Alfredsson, Cohen, Lorek, & Schroeder, 2018), and from the business community for their complexity (Slavin, 2016) due to the numerous goals and targets.

The holistic nature of the SDGs was visually represented by the SRC as nested and interconnected systems (see Figure 4). A nested perspective of the SDGs, the 'wedding cake' model, embeds economy and society into the biosphere (Rockström & Sukhdev, 2016). The model stresses a development agenda where the 'economy serves society' and both depend on the environment for survival. A WBCSD member company representative commented that the wedding cake model "challenges the thinking a little bit more […] because we need to be looking into the tradeoffs and the interconnections" (MC42).

Figure 5.4 The Wedding Cake Model of the SDGs



(Source: Folke, Biggs, Norström, & Reyers, 2016; Rockström & Sukhdev, 2016 ; Credit: Azote Images for SRC)

Interviewees felt that the SDGs are an "ambitious" and "transformational" agenda that is "much more comprehensive" than the MDGs by recognizing the complexity of interconnected economic, social and environmental issues. One WBCSD staff member commented that the SDGs are more comprehensive than the MDGs: "No one is saying, what about this? With the MDGs, there was a bit of what about this? With the SDGs, no one is saying that. So the SDGs are more, they are complex and interconnected like the world" (WB8). A senior lead at an international research organization working to engage businesses with global sustainability science said that the SDGs provide a language to speak about complex systems:

> "[The SDG framework] produces a language, a division coded, obviously an artificial division between things. But it's really nice to see so many groups in different sectors are already saying 'well, you know, you can't do SDG 1 without doing SDG 6, you can't do SDG 6 unless you solve SDG 17'. I think that's creating a new coded way of talking about complex systems."

The interviewee believed that although the goals are displayed separately and thus create socially constructed boundaries between issues, the complexity and interconnections of the agenda are not lost in dialogue.

The SDG agenda brings together diverse stakeholders to achieve a shared set of goals by 2030. Interviewees suggested that the agenda sets clear and ambitious goals for diverse stakeholders. Several informants said that the SDGs are a "gift from the UN" because the framework unites many stakeholders around common goals. The SDGs are perceived as a "universal agenda," while the MDGs targeted issues in developing countries, the SDGs incorporate pressing social and environmental issues relevant to all countries. Having shared goals and vision gives actors targets to "work towards" and facilitates collaboration by aligning different interests. A representative from a WBCSD partner international organization said:

> "It is seen as inspiring and a tangible agenda. Instead of just talking we need sustainable development, it does break it down and it does make it more tangible and more realistic in terms of achieving stuff. I think it empowers people and inspires people and clearly it has shown as an effective way to bring people together in meaningful dialogue and in meaningful collaboration" (IO12).

Since their launch, the SDGs have quickly spread as a framework to convene diverse stakeholders and establish a common language to drive action towards the 17 goals. Interviewees felt that the SDG framework provides a structure and a common language for stakeholders to "plug into" the agenda (WB28). A manager of sustainability related communications for a multi-national conglomerate said: "It provides a certain framework in which to plot all of this. To communicate all of this. To synergize all these

efforts. And I think some of them were happening in certain silos. What it does, it creates that synergy."

Interviewees expressed that communicating using the SDG language can help to establish new partnerships and to facilitate alignment between partners (PS3,9,17,20; IO1,3). One interviewee said that the SDGs are the "preferred language speaking about sustainable development" and companies are using the SDGs to find new partners (IO12). Another interviewee explained how the SDG language facilitated finding new partners:

> "Since we started speaking SDGs, we have met people like Richard Branson speaking SDGs, we met Paul Polman speaking SDGs. So we are operating at a different league. We are no longer operating in a local league we are a global league, so partnerships are coming from abroad" (PO14).

Several interviewees found the framework useful when explaining to external stakeholders the company's contribution to society and to clarify the connection between the company's mission and the societal level SDGs. A Liaison Delegate of one of WBCSD's member companies explained:

> "[The SDGs] are clearly an important framing for the whole of society. It is then incumbent upon us to do what we have to do as a business, but be clear in terms of being able to communicate to stakeholders what is the contribution that we are making to society as defined by the SDGs. So instead of us defining things that we think is a contribution to society, we can use the definition of societal contribution which comes from the SDGs" (MC33).

WBCSD Phase 3: Translating the SDGs for Businesses

Following the work on the report Architects of a Better World: Building the Post-2015 Business Engagement Architecture (see also Phase 5) (UNGC et al., 2013), UNGC, GRI and WBCSD agreed to continue the collaboration after this summit to support the private sectors' involvement in the post-2015 agenda. After a gestation and scoping period between the heads of three organizations (WBCSD, GRI, and UNGC), their teams began meeting regularly

in person and via teleconferences from January 2015 to provide a guide for business action on the SDGs, the SDG Compass. The SDG Compass outlines the steps to align corporate strategy with the SDGs and provides indicators for measuring progress. The project was built upon the "existing work" (WB5) and existing strengths of each of the organizations: "UNGC as a principle-based organization, GRI as an effective reporting standard, and WBCSD as a deep content-based organization" (GRI, 2013).

Interviewees expressed that the development of the SDG Compass proceeded without an "MOU in place" (WB5) between the three organizations or detailed project management. This led to "bumps in the journey" for example, lack of clarity regarding the budget for the project (IO1) and misunderstandings regarding responsibilities (WB5) that might have been avoided if a formal agreement with a detailed project plan was put into place. However, according to one of the project leads, these difficulties were overcome due to the continued commitment from the project leader from each of the organizations, secondees and due to time pressure to complete the report by the launch of the SDGs in September 2015.

The SDG Compass launched at the UN Private Sector Forum bringing together CEOs and heads of state during the UN Sustainable Development Summit in New York City when the SDGs were adopted. 206 chief executive officers attended the forum. Mark Zuckerberg, CEO of Facebook, Paul Polman, CEO of Unilever, Robert Collymore, CEO of Safaricom Limited, Feike Sijbesman, CEO of Royal DSM and Angela Merkel, Chancellor of Germany, are a few of the leaders that spoke about the key role of the private sector in achieving the SDGs at the forum.

Results from Reporting Matters 2016 edition demonstrate that 10 member companies disclosed the use of the SDG Compass in their report (WBCSD, 2016). In addition, the SDG Compass was translated, often by the UNGC or WBCSD global network partners, into 12 different languages. The translation of the Compass was seen as a signal of its success by the individuals involved in its creation. Furthermore, interviewees noted that the SDG Compass continues to be referenced by individuals representing

organizations that were not involved in its creations. This was also seen as an indicator of success by its creators.

In addition to the SDG Compass, WBCSD is involved in several other initiatives to translate the SDGs into business language, substantiate the business case for goals, and to provide tools for engagement. These efforts include leadership in the Business and Sustainable Development Commission and the SDG Business Hub.

The former Chairman of the WBCSD and CEO of Unilever, Paul Polman, co-founded the Business and Sustainable Development Commission (BSDC), along with Lord Mark Malloch-Brown, a former Deputy Secretary General of the UN and previous Administrator of the UNDP (BSDC, 2017). They founded the BSDC, a two year initiative spanning from January 2016 until January 2018, to develop the business case for the SDGs based on solid research. Peter Bakker and other WBCSD council members including the Chairman, Sunny Verghese (Olam), and Svein Tore Holsether (Yara) were also commissioners to the BSDC. The flagship report of the BSDC, Better Business, Better World, was launched just prior to the 2017 WEF meeting in Davos and the inauguration of President Trump. The report estimates that achieving the SDGs creates over 12 trillion USD in market opportunities (BSDC, 2017). The report suggests for businesses that are unable to capture opportunities created by the SDGs or are unprepared for market shifts, the SDGs can represent significant risks (BSDC, 2017).

In April 2016, WBCSD launched the SDG Business Hub to provide a "one stop shop" for all resources related to business action on the SDGs. The WBCSD continues to develop and publish resources in the hub for business action on the SDGs. In April 2017, the CEO Guide to the SDGs launched during the liaison delegate meeting in Montreux (WBCSD, 2017a). The CEO Guide is part of a series of guides published regularly by the WBCSD to give a "high-level perspective" of sustainability issues that impact businesses. The guide stressed that business is a vital partner in achieving the SDGs but also that long-term business success hinges upon the achievement of the SDGs. The also reiterated the results of the BSDC report, stressing that the SDGs present at least 12 trillion USD in market opportunities. At the

following liaison delegate meeting in April 2018, the SDG Sector Roadmaps launched. The report provides a set of guidelines for companies in the same sector to follow.

WBCSD Phase 2c: Reframing of the Action2020 Strategy

Interviewees expressed that societal must-haves of Action2020 are aligned with the SDGs. As one WBCSD staff member comments:

> "We now have the SDGs, which essentially are the UN's version of the must-haves. So they have gone to their own, theirs is really an Action2030 process. The SDGs are until 2030, they have gone through a very similar process, 'Where do we need to be by 2030?' So that is what the SDGs are. Now we are aligned, there is no sense having two sets of goals. We are trying to align what we are doing around the SDGs, coalescing the must-haves with the SDGs." (WB24)

As the staff member states, WBCSD now communicates using the SDG framework. The Senior Management Team decided to retain the priority areas identified in Action2020:

> **"**Then of course the world agreed the SDGs. Which is something the world has agreed. We as WBCSD and others have given input into that, but we are not running the world. So the world came up with 17 goals. If you step back from them, they are just another version of our Action2020 priorities. They choose 17 because it was political rather than just science they were listening to. The alignment between those two frameworks is 100 percent. For one moment I have been playing with the idea that the world has selected the SDGs, we should dump Action2020, just create 17 clusters in the organization. There is a point when you have to be careful with how much change can an organization handle. So I have been convinced not to do that. We keep it at the clusters we are in." (WB12)

Figure 5 graphically displays the nice priority areas of Action2020 with the SDG wheel around each one. If a priority area contributes to an SDG, that SDG is present on the wheel, if not it is absent. Furthermore, WBCSD's website was redesigned in 2016. The new version of the website positioned

the SDGs as a central theme. For each of the programs, includes a section about how that work impact on the SDGs.

Figure 5.5 Action2020 Priority Areas Mapped to the SDGs

WBCSD Phase 4: Member company adoption of the SDGs

We now discuss how the SDG framework has impacted corporate sustainability practices at the firm-level including reframing existing practices and aligning strategy with the goals. Reporting Matters, an annual review of the WBCSD member companies' reports, found that 79% of the

members have “acknowledge the SDGs in some way” while 45% have “taken it a step further by aligning their sustainability strategy to goal-level SDG criteria” (WBCSD, 2017b: 18). An initial engagement by firms may involve reframing existing sustainability communication and activities utilizing the SDG framework and language.

Reframing existing activities to the goals may be well intentioned. However, several informants expressed concern about the limitations of this practice. They warned there is a risk that existing sustainability efforts are translated into SDG language and that the framework is used primarily for marketing or reporting purposes without serious consideration for what each goal is advocating or an evaluation of what needs to be done to achieve the goals. Cherry picking describes when a company highlights the contributions of a single SDG without consideration for the interconnections between the goals. Pursuing the goals in an integrated manner helps to identify tradeoffs and synergies between the goals (Pradhan et al., 2017; Weitz et al., 2017). A director from a partner organization of WBSCD said that this level of activity is “business as usual” and “not disruptive at all.”

In an article published by *Ethical Corporation* (Slavin, 2016), *SDGs: We need more than just sunshine stories*, Malcolm Preston global sustainability leader at PwC (one of WBCSD’s member companies), said: “most companies are still telling what I call sunshine stories, the good news stories that are peripheral to their business, not core to it.” Similarly, a WBSCD staff member expressed: “I think there is too much general noise about the good things we are doing, without putting them into context. Because if we were doing enough, we wouldn't have the SDGs. So it is obviously not enough.”

Our results show that many member companies are leveraging the SDGs as a framework to understand how their current business activities relate to the goals and targets. To understand positive and negative impacts, opportunities and risks, companies are “mapping against the SDGs.” Mapping helps companies determine how core operations and strategy, sustainability or CSR activities, innovation portfolios and value chains contribute to or negatively impact the goals and targets.

Our results indicate that few companies are using the SDGs to set strategy. The Chief Sustainability Officer (CSO) of a member company responsible for integrating a long-term global sustainability strategy in approximately 50 companies explained in detail how their team is preparing for discussions with each of the subsidiaries' CEOs. The company's long-term strategy looked at what is needed to achieve a sustainable world at different milestones: "Our question is, is best practice today good enough for 2030 and 2050? In some cases, we think it is, but in many cases, we think it isn't, and so we are going to have to transform our business." The CSO continued by giving an example of the energy matrix transformation that would need to occur to meet the 2 degree Celsius emission curve and avoid bankruptcy. The CSO explained how the SDGs might provide a framework to identify factors that may disrupt the business:

> "If the road to a sustainable world in 2050 requires us to achieve the SDGs of 2030, then I could translate that into what legal requirements, what technological requirements will pull us there? What biological requirements will pull us there? What legal requirements will push us there, by 2030? And can my businesses cope with those?"

In order to convince the CEOs of the subsidiaries that the external factors identified are material to the business, he translates the 17 goals or 169 targets into risks to demonstrate how they would impact the business. He gave an example of the options that a CEO might consider:

> "Then when he realizes that it will impact his business, he is prepared to move funds to either mitigate or adapt in order to preserve his business. He has no motivation to do anything philanthropic, it makes no sense. So it has to translate directly into yes, this plant will run out of water in the next 5 years. Do I try to save the water table? Do I move the plant? Do I change the products that I make to not need water? What do I do about it?"

After translating the SDGs into risks and opportunities, they could consider strategic options. He explained: "You can't go to the board and say we must run our business on the SDGs, unless you can prove which ones will turn into a risk for your business that you have to mitigate or adapt to, or which

ones will give you an opportunity to diversify funds and a new business." This example of long-term strategic planning considering the SDGs serves as an exception rather than a norm. In fact, only 6% of the member companies reports demonstrated alignment between corporate strategy and SDG targets and had measured contribution to selected SDGs (WBCSD, 2017b).

Our results demonstrate that interviewees perceived the SDGs as a useful framework but some interviewees felt that not much had changed as result of the SDGs. To what extent the SDGs framework will provide managers with a 'roadmap' about the future regulations or market trends is still not clear. A WBCSD staff member expressed, "Well the rhetoric is, whether this is true or not, the rhetoric is [the SDGs are] your roadmap, this shows you where investment will come, where regulation will come. This is your chart to the future. I think it is too soon to know if this is actually true" (WB8).

Summary

We now summarize the eight phases identified in our case. We identified four WBCSD led phases. In Phase 1, the council developed a long-term systemic view of sustainability and published the Vision 2050 strategy document. This document provided a shared a shared understanding of the role of business in society to achieve a world which can allow 9 billion people to live well and "within the limits of the planet" (WBCSD, 2013b). Then, coinciding with the end of a leadership term, the WBCSD faced a period of stagnation and was ripe for a change. In Phase 2, Bakker became CEO of the WBCSD and shifted the focus from raising awareness to driving action. During his first 100 days in office, he presented his strategy for driving action and implemented many organizational changes (Phase 2a). He led an 18-month process to develop a collective strategy for driving change based on the PBF, Action2020 (Phase 2b). After the launch of the SDGs, Action2020 was reframed to demonstrate alignment with the SDGs (Phase 2c). In Phase 3, we show how WBCSD is actively involved in several

initiatives to translate the SDGs into business language and to develop the business case for the SDGs. In Phase 4, we demonstrate how WBCSD member companies adopted the SDGs in corporate communications and reporting.

We identified four phases related to the development of the SDGs. Following the launch of Vision 2050, international policy discussions triggered the development of the post-2015 agenda at the request of the High-Level Panel for the MDGs (Phase A). The open and inclusive nature of the post-2015 process allowed for input from the business and scientific communities (Phase B&C). The SDGs launched in September 2015 and then quickly spread as a framework to convene all stakeholders around common global sustainability goals (Phase D). At the launch of the SDGs, WBCSD, GRI, and UNGC announced the *SDG Compass.*

Discussion

The objective of this case study was to understand how social-ecological sustainability frameworks are utilized by the WBCSD and member companies. We show in Figure 1 and Table 2 eight phases of collective action for global sustainability. We show how the eight phases unfolded over time as a series of events involving collaboration between the WBCSD, member companies, scientists, international organizations and the UN. Thus, consistent with prior research, our case study demonstrates that complex social-ecological issues require collaboration between diverse actors (Hodge, 2014; Kunz et al., 2013b; Mahoney et al., 2009; Nidumolu et al., 2014; Pogutz & Winn, 2016; Whiteman et al., 2018).

Our study demonstrates that while collaboration between the WBCSD and SRC was not easy, the PBF was an effective framework for setting a collective corporate strategy grounded in science for global sustainability (Whiteman et al., 2018). The SDG framework was primarily used for cross-organizational communication and reframing existing strategies presented in corporate communications such as sustainability reports. It has also proven an effective framework for evaluating strategy (WBCSD, 2017b).

Many companies utilized the framework to map their current strategy against the SDG goals and targets. Less prevalent in our case study was the utilization of the framework for strategy setting for the WBCSD of the member companies. At the collective network level, WBCSD reframed the Action2020 in order to demonstrate alignment with the SDGs and adopted the goals as a shared language. At the member company level, most companies have adopted the SDG language for reporting and external communications. However, few companies have utilized the goals as a basis for strategy setting (WBCSD, 2017b).

Processes and tools to monitor and evaluate progress towards both Action2020 and the SDGs by 2030 are lacking. While Action2020 developed a set of 'societal must-haves', the WBCSD has yet to measure and evaluate progress towards achieving the targets. An initiative to measure progress towards Action2020 has been under discussion within the WBCSD, however, a progress report has yet to be compiled and published. Regarding the SDGs, much attention is given to developing indicators and monitoring frameworks to measure progress towards the SDGs by organizations such as SDSN, GRI, and UNGC. However, a centralized coordinating mechanism to understand the collective impact of the private sector towards achieving the SDGs does not exist. Previous research suggests that "common metrics linking specific SDGs to the Planetary Boundaries would facilitate global coordination and alignment of commitments and actions" (Clift et al., 2017). Our study also points to a need for tools to monitor progress.

In Chapter 2, we identified five core concepts of systems thinking, interconnections, feedback loops, adaptive capacity, emergence and self-organization. We now discuss the potential for social-ecological sustainability frameworks to stimulate social-ecological systems thinking (i.e. the 5 core concepts) in corporate sustainability practices (Pogutz & Winn, 2016; Whiteman et al., 2018).

Both the PBF framework and the SDGs helped to recognize interconnections between systems. The PBF helped interviewees to recognize the issues as "interrelated" (MC3) and to identify "cross-connections" (MC15) between the boundaries. As one scientist described,

"There was a lot of curiosity about ok so how do these things fit together how do they influence each other, what are the feedbacks, what leverage do we have?" (S3). These topics were "historically treated" "in silos" (MC15). Therefore, the PBF helped companies understand "the complex, non-linear characteristic of environmental systems" (Whiteman et al., 2018: 1). As such the PBF translated Earth systems dynamics into ecological materiality (Whiteman & Cooper, 2011) and priority areas for action based on science.

Close collaboration between the SRC and the WBCSD members enabled the recognition of feedback loops in complex macro-level environmental systems. Superstorm Sandy hit New York during the annual WBCSD Council Meeting 2012 in Seoul, South Korea. A scientist from SRC leveraged this surprise environmental event and explained during a keynote speech how it was related to climate change. This serendipitous ecologically material event (Whiteman & Cooper, 2011) caught member companies attention and reinforced the urgency of addressing environmental issues (Whiteman et al., 2018).

This study demonstrates the potential of the SDGs to serve as a cross-organizational and cross-sectoral framework to facilitate communication about the interconnections between complex economic, social and environmental issues of a long-term global development agenda. Our results indicate that although the use of the SDG framework stimulated communication concerning interconnections, it is unlikely this understanding is integrated at a strategic level. Interview data and the results of *Reporting Matters* suggests that the influence of the SDGs on a more strategic level within the firm was limited (WBCSD, 2017b). The results of *Report Matters* found 6% of member companies disclosed in their reports alignment between corporate strategy and the SDGs (WBCSD, 2017b).

Our case highlights the potential for social-ecological sustainability frameworks to complement each other. The PBF enabled an understanding of ecological materiality (Whiteman & Cooper, 2011) of critical Earth system processes, and through transdisciplinary collaboration enabled a collective global level sustainability strategy, Action2020 (Whiteman et al., 2018). However, while formulating Action2020, discussions of setting targets for

the social aspects of sustainability were more challenging and adequate scientific frameworks did not exist.

In the absence of solid social science for setting sustainability targets, our case shows that the SDGs can provide a globally agreed upon framework for understanding social issues. However, one limitation is the SDGs are the outcome of political processes and the majority of the targets are not grounded in science. A review of the goals and targets by scientists to determine "whether they are backed up by scientific evidence" found that of the 169 targets 29 percent are well developed, 54% should be more specific and 17 percent require significant work (ICSU & ISSC, 2015: 5–6). Nonetheless, both frameworks face limitations requiring the use of multiple frameworks to support collective action for global sustainability.

Prior research demonstrates that in addition to interconnections, other aspects of systems thinking including feedbacks, adaptive capacity, emergence, and self-organization are useful theoretical concepts to understand sustainability (see Chapter 2) (Rotmans & Loorbach, 2009; Sterman, 2001). We found little evidence that social-ecological sustainability frameworks stimulate the other aspects of systems thinking that are identified in the prior literature. One explanation could be that the other dimensions require an understanding of interconnected systems over time. Frameworks are relatively static in nature and provide a snapshot at a specific point in time. This could limit the ability of frameworks to stimulate more dynamic dimensions of systems thinking. Thus, systems theory could offer more implications for managing social-ecological systems that managers in our case do not currently address.

Based on our review in Chapter 2, prior research suggests that a change in mindset is essential to sustainable development progress (A. Williams et al., 2017). Management scholars have urged for a fundamental change in the underlying assumptions concerning the relationship between business, society and the natural environment (Gladwin et al., 1995; Seiffert & Loch, 2005; Shin et al., 2008; Shrivastava et al., 2013; Stormer, 2003). For example, Gladwin et al. (1995) called for a worldview that recognizes the complexity of interconnected economic, social and environmental systems. A more

holistic understanding calls for an analysis across spatial and temporal scales (Purser et al., 1995; Shrivastava, 1995a; Starik & Rands, 1995; Valente, 2012). Prior conceptual work suggests that changing shared mindsets is a long process that occurs by first conceptualizing the system as a whole (Meadows, 2009). Beginning with the development of Vision 2050, the conceptualization of sustainability across multiple interconnected systems over time, our case unfolds over a span of 10 years.

Empirical research on firm level adoption of systemic thinking into African agriculture and manufacturing firms demonstrates that firms are capable of experimenting with and enacting "approaches that holistically consider multiple systems" (Valente, 2012: 585). The study suggested that firms build a systemic perspectives "as an ongoing process of equitably including a highly interconnected set of seemingly incompatible social, ecological, and economic systems through collaborative theorization of coordinated approaches that harness the collective cognitive and operational capabilities of multiple local and global social, ecological, and economic stakeholders operating as a unified network or system" (Valente, 2012: 586). The network of actors was described as "highly interconnected" (Valente, 2012: 563).

Our case also demonstrates that a systemic view is developed in a network of actors. However, we found a loosely coupled fluid network of actors as opposed to a unified network. The focal organization of our case study, the WBCSD mobilizes a network of formally established member companies spread across different industry sectors and geographical locations. Within this network, we observed that while tight bonds can form quickly between a core group of actors, many of the council members meet only twice per year and the membership is consistently changing over time. The WBCSD extends the network of the member companies by acting as a unified voice representing the business community in international policy discussions. Other actors including a network of Earth systems scientists and international organizations also play key roles in establishing a long-term planetary approach to sustainability.

We hope to advance the discussions on social-ecological systems in sustainability management research (see Chapter 2) by offering an empirical account of the use of social-ecological sustainability frameworks for a global business association. It identifies eight phases by which a global business association built a long-term systemic view of sustainability and then based on insights from Earth systems science developed a collective strategy for short-term collective corporate action.

This case presented in this chapter faces two main limitations. First, the focus on one individual case limits the generalizability of the findings. Second, we relied on interviews based on mainly retrospective accounts of events with WBCSD staff, member companies, international organizations, and scientists. Therefore, we recognize that the findings of this case could be susceptible to bias. However, in order to minimize potential bias, we relied on multiple sources of data including two ethnographic accounts and documents.

Conclusion & Future Research

Prior research expressed concern about the limitations of conceptualizing sustainability at the firm level and stressed the need to account for sustainability at the planetary level (Gray, 2010; Starik & Kanashiro, 2013; Whiteman et al., 2013). Furthermore, our review in Chapter 2 demonstrates that systemic studies of sustainability fall outside of mainstream management journals (Bansal & Song, 2017; A. Williams et al., 2017).

Social-ecological sustainability frameworks present an opportunity to move beyond 'relative' notions of sustainability to a conceptualization of sustainability at the systems or planetary level (Clift et al., 2017; Whiteman et al., 2013). However, we found little research that examines the use of social-ecological sustainability frameworks as a basis for corporate sustainability. This chapter highlights the role of social-ecological sustainability frameworks as a basis for collective action. Our findings demonstrate that both the PBF and the SDGs are utilized in a global business association as a basis for strategy setting and communications.

Future research on social-ecological sustainability management research might include a longitudinal comparative case study. How does the case of the WBCSD compare to other collective efforts for social-ecological sustainability? Other comparable initiatives could include Business for Social Responsibility, Future Earth, Forum for the Future, or We Mean Business. A taxonomy of the different business initiatives for global sustainability could help to understand how the structure, levers of change and processes differ between the initiatives. More practice oriented quantitative research might develop methods, tools, and processes to measure collective corporate impact on macro-level social-ecological systems. Without new methods, tools and processes to measure the impact of global sustainability strategies over time, it is difficult to understand the effectiveness and outcomes of business solutions aimed at achieving global sustainability. This would also improve the ability to compare different initiatives.

Further research from the firm perspective is also needed. One interesting case is the Swedish outdoor sportswear company, Houdini. Houdini has collaborated with scientists from an independent non-profit organization that aims to apply the latest sustainability science in order to conduct a holistic environmental evaluation based on the PBF (Houdini, 2018). In Houdini's latest assessment report, is an analysis of the company's sustainability efforts against the PBF (Houndini, 2018). The company intends to "do full-scale third-party Planetary Assessment every third year and to go more in-depth with each assessment– moving from general LCA data to specific data for our value chain and later from past to real-time data" (Houndini, 2018: 3). This is an intriguing case because the PBF will be utilized over temporal scales and allows for an analysis of how the framework affects the company's strategy over time. Such firm level initiatives could provide valuable insights into the leading efforts to integrate social-ecological sustainability science into firm practices.

CHAPTER 6 CONCLUSION

Chapter 6 concludes the dissertation. First, I state the main contributions for each chapter of the dissertation. Second, I synthesize all of the chapters. Third, I discuss one critical avenue for future research and provide a compilation of future research from other chapters of the thesis. Fourth, I discuss managerial implications. Then I close with a final thought.

Summary of Contributions

In this dissertation, I examine corporate sustainability from a nested systems perspective. Chapter 2 reviews the literature at the intersection of sustainability management and a systems perspective. Based on this review, we develop a framework for future research to understand sustainability as nested systems. Chapter 3 posits a theory of cross-scale resilience for organization studies. Chapter 4 proposes a three-phase framework to understand cross-scale systemic risk. Chapter 5 provides an empirical investigation of the role of social-ecological sustainability frameworks in a global business association. I now summarize the main contributions of each chapter of this dissertation.

Chapter 2

This chapter contributes to the literature by answering the following research question, "What do we know about sustainability management

research which leverages a systems thinking theoretical lens?" Based on a systematic review of the literature, we find that most of the literature at the intersection of sustainability management and systems theories fall outside of mainstream management journals in transdisciplinary journals. From our results, we identify five core concepts, interconnections, feedback loops, adaptive capacity, emergence, and self-organization. In addition, we identify eight research themes, behavioral change, leadership, innovation, industrial ecology, social-ecological systems, transitions management, paradigm shifts, and education. Furthermore, we demonstrate to what extent the research themes address cross-scale interactions and where gaps still exist.

Chapter 2 provides a multi-level framework to guide future research. The framework recognizes the interconnections between nested systems. Our multi-level framework connects levels of analysis including individual, organizational, inter-organizational, societal, and environmental. The framework suggests that individuals are embedded in value systems and organizations are embedded in inter-organizational networks and society. All of these systems depend on the natural environment for critical resources and survival. We recognize this framework focuses on spatial scale, and does not pay due attention to the issue of temporal scales.

Chapter 3

Chapter 3 posits that most studies of organizational resilience tend to focus on organizational responses to external threats. However, we argue the resilience of individual organizations is also dependent on the resilience of broader systems. Building on insights from the natural sciences, we demonstrate that issues of scale are critical to prevent enhancing resilience at one scale while potentially detracting from resilience at another scale.

We build on an example of Unilever and palm oil production in Borneo (Whiteman et al., 2013) to support our argument. In our example, we consider the potential disconnect between building organizational resilience and that of social-ecological resilience. We began with the Bornean rainforests as the focal scale. Then we demonstrate the impact of

palm oil and tropical timber production on nested social-ecological systems. We discuss how feedback mechanisms between local deforestation and climate change result in climate related impacts in Unilever's supply chain. Our example draws attention to the importance of cross-scale resilience for organization studies.

Chapter 3 develops several propositions related to cross-scale resilience for future research. We suggest propositions about the pace of social-ecological change, thresholds of social-ecological systems, time delays, degree of interconnectedness, and building cross-scale resilience (see Table 6.1). We hope this chapter offers a conceptual basis to move towards a more holistic understanding of resilience.

Chapter 4

Chapter 4 argues organization research has yet to explore the role of organizations as creators and recipients of systemic risks across scales. We review the literature concerning organizational risk and the natural environment along two dimensions. First, we examine if environmental risks are considered at a discrete point in time or as a process that unfolds over time and space. Second, we consider the directionality of the threat. We argue that an integrative framework to examine feedback loops across organizations and between social-ecological systems is missing from the literature.

To address this gap in the literature, we develop a three-phase framework for analyzing systemic risks arising across spatial and temporal scales. The framework suggests: building a planetary view of organizational risk across scales, understanding planetary risks and building organizational and societal adaptive capacity for managing planetary risks. This framework provides a foundation for understanding environmental risks arising from complex interactions across spatial and temporal scales.

Chapter 5

Chapter 5 is based on an empirical case study of a global business association examining the implications of social-ecological sustainability frameworks for corporate sustainability. We argue that despite scientific

and political advancements to develop social-ecological sustainability frameworks, little research examines the implications of these frameworks for corporate sustainability. We ask the following research question: How are social-ecological sustainability frameworks utilized as a systemic basis for collective strategic planning and communication in a global business association?

We conducted a qualitative case study of the World Business Council for Sustainable Development (WBCSD), spanning from 2008-2018. Our sources of data include interviews, documents, an ethnographic study, and two personal accounts. During the course of the case, the council utilized two social-ecological sustainability frameworks, the Planetary Boundaries Framework (PBF) and the UN Sustainable Development Goals (SDGs), as a basis for strategic planning and communication. We present our findings in eight overlapping phases. Our analysis shows that in Phase 1, WBCSD developed a long-term systemic view of sustainability known as *Vision2050.* The end of a leadership term at WBCSD and arrival of a new leader trigged the focus of the network to shift from aspiration to driving action (Phase 2). Peter Bakker, the new CEO of WBCSD, started in January 2012 and in his first 100 days (Phase 2a) established a plan for driving action. The development of Action2020, a collective strategy for sustainability began during an annual WBCSD member meeting in April 2012 (Phase 2b).

We find that WBCSD's strategy development co-evolved with international policy discussions. Commencing during the development of Vision 2050, discussions at the UN triggered the development of the post-2015 agenda (Phase A), followed by business and science inputs to the post-2015 processes (Phase B&C). In September 2015, the SDGs launched (Phase D) and then the WBSCSD and others translated the SDGs for businesses (Phase 3). Action2020 was then reframed to demonstrate alignment with and contribution to the SDGs (Phase 2c) and member companies adopted the framework in corporate reporting, communications and strategy setting (Phase 4).

Our analysis shows that the PBF was an effective framework for setting a global sustainability strategy based on science and the SDGs were utilized

primarily for communication and reframing existing sustainability strategies. Both frameworks helped the council to understand the interconnections between nested systems.

In Table 6.1, I summarize the contributions of each chapter.

Table 6.1 Summary of Contributions

Chapter 2
Reviews the literature at the intersection of sustainability management and a systems perspective
Finds that literature at the intersection of sustainability management and a systems perspective lies outside of mainstream management journals
Identifies 5 core concepts (interconnections, feedback loops, adaptive capacity, emergence, and self-organization)
Identifies 8 research themes (behavioral change, leadership, innovation, industrial ecology, social-ecological systems, transitions management, paradigm shifts and education)
Demonstrates to what extent each of the research themes addresses cross-scale interactions and where gaps still exist
Develops a multi-level framework for future research
Chapter 3
Contributes a conceptual basis that examines resilience across temporal scales and across nested social-ecological systems which affect and are affected by organizational action
Chapter 4
Provides an overview of organizational risk literature *concerning the natural environment along two dimensions:* (1) We examined if environmental risks are considered at a discrete point in time or as a process that unfolds over time and space, (2) Then we considered the directionality of the threat
Provides a long-term, systemic perspective of planetary risks that recognizes the embeddedness of organizations in the natural environment
Proposes a three-phase framework for analyzing systemic planetary risks: (1) building a planetary view of organizational risk across scales, (2) understanding planetary risks, (3) building organizational and societal adaptive capacity for managing planetary risks

Chapter 5

We identify eight phases of collective action for global sustainability. During the four WBCSD led phases, the council utilized two social-ecological sustainability frameworks:

1 Developing a Long-Term Systems Perspective, *Vision2050*

2 Driving Action (2a First 100 Days; 2b Developing Action 2020; 2c Reframing Action 2020)

3 Translating the SDGs for Business

4 Member company adoption of the SDGs

In addition to the four WBCSD led phases, we identify four SDG phases:

A Triggering the Post-2015 Agenda

B Science Input to the SDG Process

C Business Input to the SDG Process

D SDG Agenda

Our timeline identifies 27 significant meetings, 10 presentations, 4 speeches, the launch of 19 significant reports, and 36 important turning points during the development and utilization of two social-ecological sustainability frameworks

We find that the PBF was an effective framework for setting a collective corporate strategy grounded in science for global sustainability

We find that the SDGs was utilized for cross-organizational communication and reframing existing strategies

We contribute an empirical case about the role of social-ecological sustainability frameworks as a basis for collective strategy setting and communication in a global business association

Synthesis

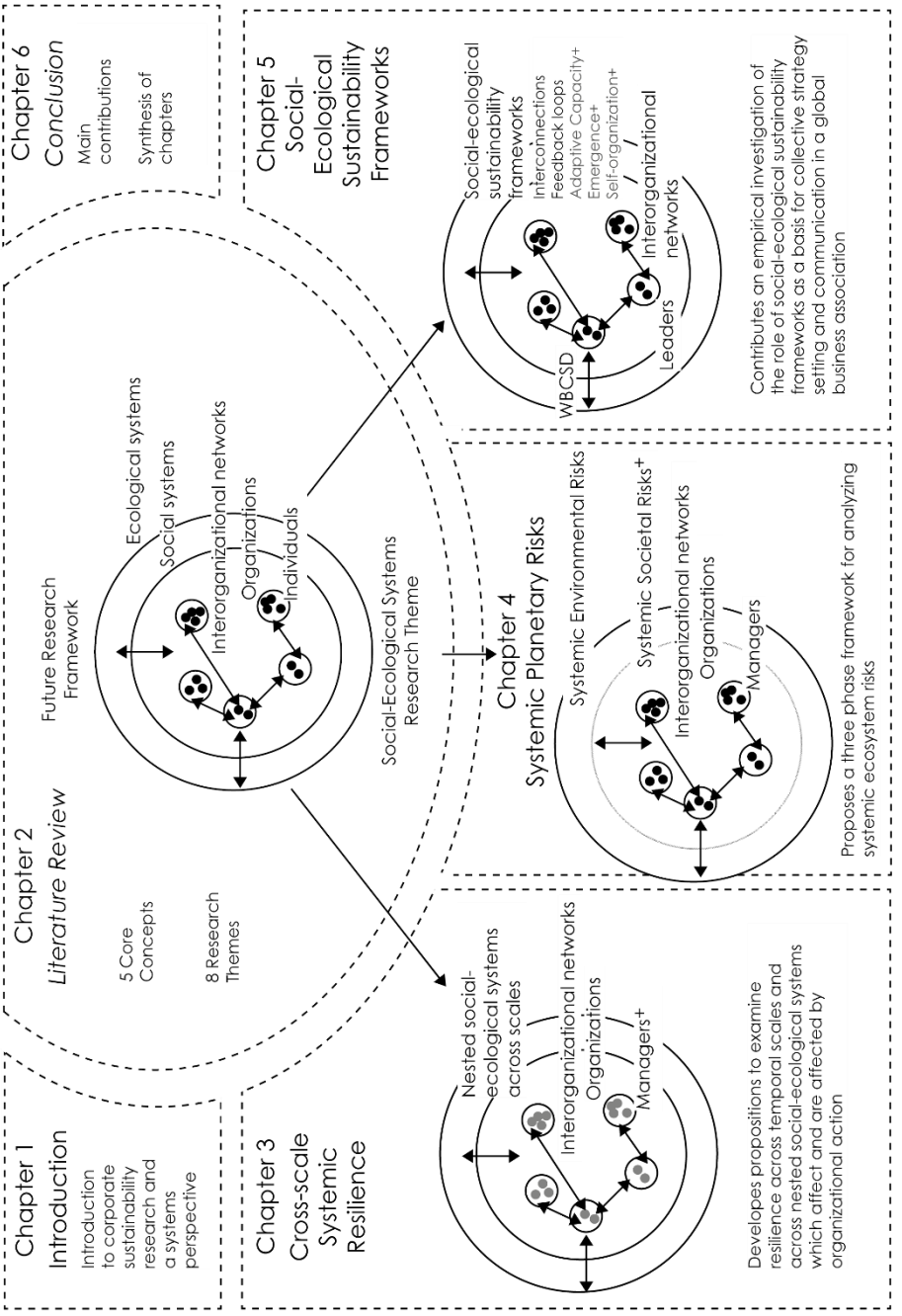
In the second chapter of this dissertation we propose a framework for future research "to explicitly recognize social-ecological embeddedness beyond the boundaries of the firm, industry, and product/process level, as well as the interconnections across multi-level, nested social-ecological systems" (A. Williams et al., 2017: 877). We argue, along with others, that sustainability requires a systemic perspective recognizing the dependence of business and society on the natural environment (Gladwin et al., 1995; Hahn et al., 2015; Hart, 1995; Jennings & Zandbergen, 1995; King, 1995;

Purser et al., 1995; Starik & Kanashiro, 2013; Starik & Rands, 1995; Whiteman et al., 2013; Winn & Pogutz, 2013).

Alternative conceptualizations of the relationships between business, society and the natural environment are the disparate and intertwined views (Marcus et al., 2010). The disparate view separates society and the natural environment from business activities and is implicit in management studies and neoclassical economics. The intertwined view positions society and the natural environment as integrated with business activities and was popularized by the triple bottom line concept (Elkington, 1997). The triple bottom line suggests that firms should reconcile financial, societal and environmental performance. The intertwined view has received much scholarly attention and uptake. However, scholars argue that the triple bottom line is a simplified notion of a complex concept. The triple bottom line concept received criticism that it fails to capture the complexity of sustainability and offers a potentially misleading view of sustainability progress (Gray & Herremans, 2012; Marcus et al., 2010). The individual components, financial, societal and environmental, do not compromise the whole resulting in a "compositional fallacy" (Bansal & Song, 2017: 125). Furthermore, “the Triple Bottom Line does not – and in all probability cannot—provide guidance on the extent to which an organization is contribution to, or detracting from, the sustainability of social and ecological systems” (Gray & Herremans, 2012: 412).

Chapter 2 establishes a systems perspective as a foundation for the remaining chapters of the thesis. In these chapters, we focus on one of the research themes that we identify in the review, social-ecological systems research. I now synthesize the advancements made in this dissertation across the individual chapters. For a graphical representation, see Figure 6.1, which I now explain in detail.

Figure 6.1 Synthesis



Beginning with the upper left corner of Figure 6.1 is the introduction of the thesis (Chapter 1). In this chapter, I introduce corporate sustainability research to position this dissertation in the field. Then I introduce a systems perspective of sustainability management.

Moving to the upper center of the diagram, I show that Chapter 2 of the dissertation reviews the literature at the intersection of sustainability management and systems thinking. The review identifies five core concepts and eight research themes. Within the section for Chapter 2, I show a simplified version of the framework for future research (see also Figure 2.4). By placing the framework for future research in the center of Figure 6.1, I show how this figure, and one of the research themes, social-ecological systems, provides the foundation for the remaining chapters of the thesis.

Then, in the bottom left corner of Figure 6.1 is Chapter 3, a conceptual chapter. Chapter 3 focuses on the relationship between organizational and social-ecological resilience. We develop a series of propositions concerning the relationship between organizational and social-ecological resilience. Figure 6.1 identifies that the relationship between individual managers and broader cross-scale resilience remains unexplored. Therefore, the individuals are grey dots in the diagram and the label for 'managers' is followed by a '+' symbol to demonstrate a gap that we did not address.

Next, in the bottom center of Figure 6.1, Chapter 4 focuses on the reciprocal relationship between systemic ecosystem risks and collective organizational action. We propose a framework for how individuals can analyze systemic ecosystem risks. Figure 6.1 identifies that consideration for systemic societal risks. Therefore, the circle for societal systems is grey and the label for 'systemic societal risks' is followed by a '+' symbol to demonstrate a gap that we did not address.

Then, in the lower right corner of Figure 6.1, Chapter 5 focuses on the role of two social-ecological sustainability frameworks as a basis for collective strategy setting and communication in a global business association. We present how the WBCSD utilized the frameworks in nine overlapping phases. We suggest that future research could consider other cases of collective action for global sustainability and the role of social-

ecological sustainability frameworks for firm-level strategy setting. We found that the PBF and the SDGs stimulated a recognition of the interconnections and feedbacks between complex sustainability issues. However, we found less evidence that these frameworks stimulate other aspects of systems thinking that we identified in Chapter 2 including adaptive capacity, emergence and self-organization. Therefore, these concepts of systems thinking are in grey followed by a '+' symbol to demonstrate a gap that this empirical case study did not address.

Finally, in the upper right hand corner of Figure 6.1, is the conclusion of the dissertation (this chapter). In this chapter, I summarize the main contributions of the chapters and synthesize the work.

Individually the chapters contribute to our understanding of corporate sustainability from a systems perspective. Chapter 2 reviews the relevant literature, contributes an understanding of what we already know about the field and provides a foundation for the rest of the thesis. Together, chapters 3 and 4 show us conceptually how cross-scale resilience could be managed. Chapter 3 focuses on the relationship between organizational and social-ecological resilience to demonstrate why managing cross-scale resilience is crucial. Following this work, Chapter 4 introduces a more granular three-phase framework for how a manager could start to manage long-term systemic resilience across spatial scales. Chapter 5 provides an empirical study of how the WBCSD in practice convenes multi-national corporations to manage social-ecological systems in the long term. The conceptual work in this thesis demonstrates how theoretically a manager would leverage insights from systems thinking, and the empirical work demonstrates a leading real world example.

Future Research

In addition to the gaps I identify in the synthesis diagram (Figure 6.1), each of the individual chapters contains avenues for future research. See Table 6.2 for a compilation of future research questions. One critical avenue for future research is longitudinal comparative case studies on collective

corporate efforts aimed to achieve social-ecological sustainability. In order to compare case studies, this work requires the development of methods, tools, and processes to measure the effectiveness of collective corporate efforts for global sustainability. More specifically, we need to develop methods to measure the collective impact of companies against social-ecological frameworks such as the PBF and the SDGs. For example, one might empirically study how current WBCSD business solutions address the issues defined by the PBF and the SDGs. Then with the proper measures in place, one could compare and contrast the effectiveness of various efforts and identify the barriers, facilitators and enabling factors across cases.

Table 6.2 Future Research for Organization Studies

Chapter 3
Empirical investigation of the propositions:
Proposition 1a: When managerial approaches suffer from a focal scale bias (and narrowly interpret resilience as an organizational variable), important cues from other spatial scales are overlooked, leading to a decline in cross-scale resilience
Proposition 1b: Managerial approaches that interpret social-ecological issues based on properties of complex adaptive systems (multi-scale, nested feedbacks) enhance cross-scale resilience
Proposition 2a: When managerial approaches do not identify slow variables and monitor their changes with respect to threshold limits, important ecological cues are overlooked, leading to a decline in cross-scale resilience
Proposition 2b: Managerial approaches that identify and monitor slow variables across ecosystems in which they operate will enhance cross-scale resilience
Proposition 3a: When managerial approaches do not monitor functional redundancy and response diversity of ecosystems in which they operate, important cues on cross-scale resilience may be overlooked leading to cross-scale vulnerability
Proposition 3b: Managerial approaches that maintain functional redundancy and response diversity of ecosystems in which they operate will enhance cross-scale resilience

Chapter 4
Transdisciplinary empirical research (with natural scientists) to address planetary risks to and from organizations
Empirical case study research to identify the barriers and enablers of the proposed framework (see Figure 4.2), including a deeper analysis of the role of entrenched vested interests and power relations
Empirical case study research to understand the impact of long-term systemic societal risks (for example, migration, social instability, and terrorism)
Chapter 5
Empirically study how current WBCSD business solutions address the issues defined by the PBF and the SDGs
Development of methods, tools, and processes to measure the effectiveness of collective corporate efforts for global sustainability
Longitudinal comparative case studies on collective corporate efforts aimed to achieve social-ecological sustainability
Comparative case studies of firm level strategies to integrate social-ecological sustainability knowledge into corporate strategy and decision making

Managerial Implications

This dissertation stresses the importance of, and need for, a long-term systemic approach to addressing the world's complex and interconnected economic, social and environmental issues (Rockström, Steffen, Noone, Å. Persson, et al., 2009; Steffen, Richardson, et al., 2015; United Nations, 2018). The results of Chapter 5 demonstrate the willingness of multi-national companies to formulate collective strategies and communicate on a social-ecological systems level. Furthermore, it demonstrates that this willingness did not manifest recently, but has been emerging since at least 2008 and possibly even as far back as the Rio Earth Summit in 1992 when discussions about the role of business in the global development agenda began. Chapter 5 also indicates the potential value in utilizing social-ecological frameworks to integrate systems thinking into corporate strategy setting and communications to build cross-scale resilience.

Despite these encouraging signs (such as a collective corporate interest in systems level sustainability), global risks remain a real concern for

businesses (WEF, 2017). Chapter 3 provides one example of systemic risks that managers face. In this chapter, we discuss the consequence of climate change for Unilever which costs the company up to €300 million a year (Polman, 2015). We argue that if the boundary conditions of the issue are set at a broader level and scale, the solutions for addressing environmental degradation along Unilever's supply chain may change. We find that most current approaches focus on how to build organizational resilience to external threats. However, we suggest that by taking a nested systems perspective of the complex issues associated with land use change in Borneo could stimulate a cross-scale approach to managing resilience. A cross-scale approach for managing resilience shifts the focus from managing the consequences of climate change to the cross-scale issues in Borneo including land use change, biodiversity loss, climate change and impact on rural livelihoods. We suggest one solution to the issues in Borneo might be land restoration. Therefore, systems thinking might help managers to think about the root cause of problems differently (Meadows, 2009), implement different solutions, track performance and manage resilience across scales.

Chapter 4 suggests a process for implementing long-term cross-scale strategy for managing systemic planetary risks. The three-phase framework (see Figure 4.2) demonstrates a possible approach for managers to formulate a collective strategy for social-ecological sustainability. First, the managers could build a planetary view of interconnected economic, social and environmental issues over time. This involves risk management decisions today to examine local, regional and global level risks at several time scales. We found in Chapter 5 that WBCSD utilized the PBF to examine global systemic ecosystem risks. This case also demonstrates that the SDGs are another framework organizations utilize to build a planetary view of interconnected cross-scale issues. However, we suggest in this phase a consideration at local and regional levels where the organization operates. The PBF and the SDG are both global in nature. Companies could collaborate with scientists and experts to develop a more nuanced view to allow for the level of granularity necessary.

Second, they might build an understanding of the reciprocal feedbacks and interdependence of these issues. Research suggests important aspects of this phase include developing a shared understanding of risks (T. A. Williams et al., 2017) and identifying subtle and abrupt cues which may signal risk and danger (Whiteman & Cooper, 2000). This process can be facilitated by social-ecological sustainability frameworks combined with local knowledge of grassroots change (Whiteman et al., 2018; see also Chapter 5). Chapter 2 demonstrates conceptually how a company might approach this phase.

Finally, collectively managers can build adaptive capacity to long-term cross-scale systemic risks. Given the complexity and uncertainty inherent in such risks, approaches of prediction and planning are often insufficient (Sullivan-Taylor & Wilson, 2009). Building adaptive and transformative capacity may allow managers to cope with systemic risks (Walker et al., 2004). Transdisciplinary sustainability science can offer insights for this final phase of building social-ecological resilience. In a review of the literature, Biggs et al. (Biggs et al., 2012a) identify the core principles of building social-ecological resilience.

However, how many universities provide a systems thinking education for managers? When a company transitions to a long-term systemic strategy for sustainability, it could uncover a lack of appropriate knowledge and skills. Donella Meadows (2009: 3), environmental scientist and systems thinker, comments on why we often fail to recognize the principles of systems theory: "We have been taught to analyze, to use our rational ability, to trace direct paths from cause to effect, to look at things in small and understandable pieces, to solve problems by acting on or controlling the world around us." The results of Chapter 2 similarly demonstrate that within corporate sustainability management research, systemic discussions of sustainability lie outside of mainstream management journals. A key question is then if and how systems thinking enters business school education and research. While this question is outside of the scope of my research, it is an important line of inquiry for future research.

My thesis suggests that a systemic perspective is important for leadership training and business school education. However, when a company transitions to a long-term systemic strategy for sustainability implementing the three-phases from Chapter 4, they could uncover lack of appropriate knowledge and skills. If a company does realize this limitation, they may wish to develop the required knowledge and skills and explore avenues to achieving the desired competencies. This suggests that this thesis has important managerial implications for business school deans and HR directors responsible for the training and development of employees. First, I discuss my advice for business school deans and include a specific section about RSM. Then I give recommendations for HR directors.

Business schools prepare university students for their future careers. Business schools deans can include systems thinking in the education and skills students receive during their studies to prepare them to tackle grand challenges in their future careers. An evaluation of the university's research and education would provide a starting point. In Table 6.3, I provide specific advice for RSM.

Table 6.3 Implications for RSM

Encouragingly RSM announced a new mission in June 2017 to be a 'force for positive change.' To live up to this mission, RSM adopted the SDGs as a guiding framework. I now provide advice for how RSM might live up to its mission. First, I suggest conducting a thorough evaluation of the education that RSM provides. This evaluation would answer if RSM provides the appropriate training to bachelors, masters, executive education and PhD students to prepare them to manage cross-scale resilience. The bachelors' program is currently undergoing revisions to live up to the new mission and the leaders of this initiative are discussing options to integrate managing complexity into the core of the bachelors' program. Also, led by Eva Rood, we are developing online learning modules for each SDG for the students at RSM. I incorporated systems thinking into the introduction of these modules and stressed the importance of the embedded perspective as a foundation for these modules (see also Figure 5.4). If these modules become a requirement (which is currently under discussion) then all students will have exposure to the basics of systems thinking.

Conducting the evaluation is just the first step. The Sustainable RSM initiative, led by Joey Johannsen, amongst others already conducted a number of evaluations. A critical next step is then to act on the results of the evaluation and to identify the systemic barriers to integrating sustainability across the organization. Support and commitment from the university's top administrators would help. Then RSM might consider if the proper incentive and evaluation structures are in place to support sustainability education. Embedding a culture of sustainability across the organization would also help. See Bertels, Papania, and Papania (2010) for a review of this topic.

Next, RSM plays a critical role in achieving the SDGs by conducting research about pressing social-ecological challenges. Given the freedom of academics to determine their own research agenda, it may be more difficult to change the faculty member's research agenda. RSM can however encourage and reward societally relevant research that goes beyond 'financial sustainability' as the main measure and encourage research that more holistically considers the role of organizations in interconnected social-ecological systems. One consideration might include evaluating the ERIM Journals List. This list plays a significant role in evaluating the quality of the output and productivity of RSM academics. The critical question here is do the journals represent the best outlets for publishing research related to grand challenges or the SDGs? Furthermore, is the appropriate weight given to journals that focus on these issues? A careful evaluation and revision of this list could help drive more research on topics related to the role of management in achieving the SDGs.

RSM should go beyond education and research. The university might consider its impacts against social-ecological sustainability frameworks over time. A critical question is then how does RSM impact all of the SDGs? For example, how does RSM contribute to climate change, SDG 13? RSM might consider first the sizeable impacts of travel to conferences and likewise the travel of guest speakers to RSM. Can RSM reduce its impact? Or even offset its impact on climate change? Or better yet, positively contribute to SDG 13 by acting as a carbon sink. Or another example, how does RSM contribute to the good health and well-being of its employees (SDG 3)? Over the past 5 years at RSM I witnessed a fair share of 'burnouts' and numerous PhD students struggling with maintaining a balanced mental health. How can RSM create an open atmosphere to address these issues at their root cause? These are critical questions if RSM really wants to be 'a force for **positive** change in the **world**' (see https://www.rsm.nl/positive-change/). I've added the emphasis on positive and world. I added this

emphasis to stress that the mission is not about being less bad, it is about making positive impacts across all the SDGs. And this must be measured against sustainability metrics and targets at a global level (i.e., social-ecological sustainability frameworks, see also Chapter 5).

All of these aspects deserve very careful attention and consideration to truly establish RSM as a force for positive change and as a university committed to achieving the SDGs. After working on the SDG learning modules with Eva Rood, I am encouraged to see many RSM employees that are willing and committed to change and that personally motivated to make a difference. The university built a foundation to work from by integrating sustainability core courses into the Bachelors and MBA programs. The MSc offers an entire sustainability program and electives. In 1997, the university established the department of Business-Society Management focused on the relationship between business and society. Then a key question for RSM is how to create the structure and processes for this bottom-up change to emerge and drive change across scales?

I now discuss three options for Human Resource Managers at companies to develop skills in systems thinking. First, to develop systems thinking capabilities, firms may implement training programs for decisions makers. Training programs would likely include the fundamentals of systems thinking and the leading sustainability science. In addition, they could also include experiential learning techniques by showing managers the societal and environmental impacts of the company's supply chain, could provide powerful and eye opening learning experiences. Trained decisions makers embedded across the organization could facilitate the implementation of a global sustainability strategy.

Second, instead of developing internal training programs, companies may seek this knowledge externally or through collaborations with international organizations, scientists or consultants. For example, the WBCSD offers a leadership program "designed to help leaders navigate complex, interdisciplinary topics" related to achieving global sustainability (WBCSD, 2018b). Collaboration with international organizations such as Forum for the Future could offer knowledge about driving systemic change for sustainability. The SDG Academy offers a wealth of knowledge and Massive Open Online Courses (MOOCs) freely available online (see

https://courses.sdgacademy.org/). And the Santa Fe Institute offers free online courses in its 'Complexity Explorer' program covering the basics of systems dynamics and more advanced topics.

However, most systems theory or sustainability MOOCs do not incorporate a business perspective. The findings of this thesis can translate into educational materials for business schools. For example, since I have arrived at RSM, I added (at the request of and support of Steve Kennedy) a module on systems thinking and resilience thinking to the Global Business Stakeholder Management Masters and the second chapter of the thesis is a required reading for that lecture. Furthermore, I discussed my role in introducing the systems thinking in the SDG learning modules earlier in this chapter.

Third, companies may work with business schools to identify skills that are required to manage cross-scale resilience and discuss how to best develop those skills across the university's programs. Furthermore, companies could collaborate with academics to develop case studies and learning tools for understanding complex social-ecological issues. Business school graduates would then be in a better position to tackle cross-scale systemic issues upon graduation.

A Final Thought

The introduction of this dissertation opens with the campaign slogan of President Trump, '*Make America Great Again.*' In order to keep his promise to make American great again, Trump announced the nation's withdrawal from the Paris agreement arguing that it stifles American competitiveness. I argue that the decision of Trump to withdraw from the Paris agreement, despite the alarming number of extreme weather disasters in the US during 2017, demonstrates a lack of ability to identify and act upon cross-scale feedbacks. Or simply put, a lack of a systems perspective.

If the Trump administration suddenly woke up and realized that their decisions negatively impact broader systems and feedback over time, they might reconsider decisions such as withdrawing from the Paris agreement.

They might begin to make decisions based on more holistic considerations of feedbacks across spatial and temporal scales (for example see the framework in Chapter 4 and the discussion in the managerial implications in this chapter).

Regardless of whether such a dramatic change is possible, others in the country have responded with a more holistic approach. Triggered by Trump's withdrawal, a bottom-up multi-actor initiative across local, regional and state levels including multi-national companies was born to fulfill America's commitment to the Paris agreement. This demonstrated that despite lack of national political will, many U.S. based companies are committed to a more systemic view of sustainability and to building cross-scale resilience even when it is not mandated by national regulations. Reading about the commitment of multi-national companies following the election of Trump (Tabuchi, 2016) gave me hope and motivation. Hope that despite political will, we would find a way to fulfill the agreement. This ultimately gave me the motivation to continue my research.

I began this PhD over 5 years ago with little knowledge about systems theory. Inspired by the work of my supervisor, Gail, colleagues from the I4S network, including Nigel Roome, Sally Jeanrenaud, and Kosheek Sewchurran, I set out to find out what we know about sustainability management from a systems perspective and wrote my proposal about cross-scale systemic change for global sustainability.

The doctoral program taught us primarily about classic, more mainstream organization theories such as resource dependence theory, institutional theory, institutional work and logics, behavioral theory of the firm and organizational ecology (do not confuse the term ecology to mean natural environmental systems). The professor of the course left a blank paper on the desk at the front of the class at the end of the first session. On this blank sheet of paper, he said the PhD students could indicate other theories they were interested in learning about during the course that were not already on the syllabus. I wrote 'systems theory/ complexity theory.' Despite my request, we did not have a session addressing either of these suggestions.

So I taught myself. I enrolled in the Systems Dynamics Summer School at TU Delft. I read the works of Dennis and Donella Meadows. I read Panarchy by Lance Gunderson and C.S. Holling. I engaged with science from other academic fields. I watched MOOCs on the natural sciences and transdisciplinary sustainability science.

I received pushback along the way. During my proposal presentation, the I4S senior academics told me it was too complex, that I need to focus on one-level. During brainstorming sessions with another scholar, he drew boxes and straight lines on the whiteboard. He asked 'where is your IV and your DV?' My supervisor, although always supportive of any path I chose, wondered how I would possibly manage to write a paper using 'Panarchy' (see Chapter 3). These are all the risks that the academic community tried to warn me about.

Despite these setbacks and words of caution, I continued to work on what I believed was a relevant approach for understanding the complexity of sustainability issues. I reviewed the relevant literature and sent my first article to journals. The paper was rejected from two mainstream stream management journals. The rejections were not surprising since my results found that despite early calls for a systems perspective, few articles were published in mainstream management journals since 1995. I published the article in a transdisciplinary journal (the *Journal of Cleaner Production)* which is versed in systems thinking. I was encouraged to receive feedback that scholars were actually reading the article. The article was discussed at a reading group, stimulated a transdisciplinary workshop, inspired other PhD and Master's students on their thesis and it continues to be actually cited.

After I published my first article, the rest of the journey was anything but easy. I hit several road bumps. More rejections. Ran out funding. I almost quit on several occasions. The conditions seemed volatile, complex and uncertain. I tested the limits of my own resilience. But since you are reading these last words now, we can celebrate. I made it.

How did I make it? I noticed, recognized and then acted upon my own limitations. As I neared thresholds, I relied on my ability to adapt. I reacted

to my own thresholds by seeking the help of two personal coaches during my PhD. Their words of wisdom and training techniques were genius and simple but kept me going (Thank you Eldridge and Marion). I retreated into nature. Disconnecting and climbing mountains allowed me to both physically and mentally renew. I could feel the impact of work on my body each time I went back to hiking.

Having two worlds, academia and practice, also helped. Going back to the field was always a source of inspiration. It reenergized me. I was lucky to have the support of the WBCSD, especially from Rodney Irwin and the Redefining Value team. I was thankful I had a different world to emerge in and that I didn't spend all five years of my PhD stuck behind a computer screen. The time I spent completely away from the field during the end of my PhD was the most difficult.

Climbing, swimming, and yoga provided short-term fixes. Either by releasing physical energy or relaxing my mind and connecting to my physical self. I found Davide. We reminded each other that there is more to life than work. We made jokes to lessen the pressure we were under. He is my balancing feedback loop. My supervisors were at times the source of my pain. But they were always there to listen and provide support. They encouraged me to do my best. I am thankful they took the time to read my thesis again and again. They were the reinforcing feedback loop that drove continuous improvement and I could not have done it without them.

I likely transitioned over thresholds into a new unfavorable regime at least once or twice. I told my supervisor I did not like the person I had become. Those periods of collapse were rough but I eventually allowed myself to recover. I have learned over the course of my PhD, that as individuals we manage our own resilience and our own adaptive capacity. Individuals in leadership positions are in a unique position to align their own cycles of renewal with the dynamics of the organization. For instance, in Chapter 5 we show how a leader recognized he could no longer bring fresh ideas to his organization. By changing organizations he was able to align his individual phase of renewal with that of the new organization and drive cross-scale action towards systems level sustainability. How

individual resilience cascades to build resilience across scales is thus an important question that I identify (in Figure 6.1 for Chapter 3) for future research.

Multi-national corporations and nations are facing systemic planetary risks and complex social-ecological issues. The consequences of these risks are real and the problems we face are grave. Encouragingly, some multi-national companies (and Macron if he lives up to the promise of his slogan) are aiming to build cross-scale resilience to cope with the uncertainties of volatile future. To '*Make Our Plant Great Again*' we need more systems thinkers. We need more systems knowledge integrated into everyday managerial action, management research, and management education. We need more leaders to stand up against the norms, set aside their differences and work together across boundaries. At the end of the day, we are all just people trying to make a difference. And that gives me hope.

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SUMMARY

This dissertation aims to advance our understanding of sustainability management. In Chapter 1, I introduce corporate sustainability research to position the contribution of this dissertation. I show that early research in the field called for a systems perspective that recognizes the limits posed by the natural environment. Following these early calls in the literature, the firm level became the area of concern. More recently, two streams have emerged to provide a holistic understanding of sustainability, a paradox perspective and systems perspective. I seek to contribute to the second stream. I then introduced a systems perspective of corporate sustainability including dimensions of scale and embeddedness. Finally, I outlined the reminder of the thesis and declared the contributions of others.

Chapter 2 reviewed the literature at the intersection of sustainability management and a systems perspective. We conducted a systematic literature review of the sustainability management literature from 1990 until 2015, resulting in 96 articles. Our results show that 54 percent of articles were published in two transdisciplinary journals, suggesting that a systemic approach to sustainability management is not yet prevalent in mainstream management journals. From the 96 articles, we identified and described 5 core theoretical concepts of systems thinking found including interconnections, feedbacks, adaptive capacity, emergence and self-organization. Findings show 9 research themes, including behavioral change, leadership, innovation, industrial ecology, social-ecological systems, transitions management, paradigm shifts and sustainability education. We conclude the chapter with a cross-scale integrated framework to guide future research.

Chapter 3 argued that the existing literature on resilience in management journals focuses primarily on the resilience at the organizational level, what factors enhance or detract from organizational viability in the face of threat? While the focus on resilience of organizations provides important theoretical contributions, organizational resilience also relies upon the resilience of broader social-ecological systems in which the

firm is embedded. Therefore, we argue that long-term cross-scale resilience cannot be well managed without an understanding of the feedback effects across nested systems. For instance, a narrow focus on optimizing organizational resilience from one firm's perspective may come at the expense of social-ecological functioning and ultimately undermine management efforts for long-term organizational survival. In this chapter, we integrate insights from natural science to help organizational scholars to examine cross-scale resilience and conceptualize organizational actions within and across temporal and spatial dynamics to manage for cross-scale resilience. Drawing on documents and a published example of palm oil production in Borneo, we illustrate a nested systems perspective of palm oil extraction that is highly relevant for organization scholars. Furthermore, we develop propositions for future research on managing for cross-scale resilience.

Chapter 4 proposed that that organizational studies of risk can benefit from natural science insights on systemic ecosystem risks at the planetary scale. We provided an overview of the organizational risk literature concerning the natural environmental along two dimensions. First, we examined if environmental risks are considered at a discrete point in time or a risk that unfolds as a process over time and space. Then we considered the directionality of the threat. Based upon our review, we argued that the complex role of organizations as collective contributors to and recipients of systemic risks at the planetary level remains underexplored in organization studies. We proposed a three-phase framework to examine feedback loops across organizations and between social-ecological systems.

Chapter 5 addressed the research question: How are social-ecological sustainability frameworks utilized as a systemic basis for collective strategic planning and communication in a global business association? We conducted a qualitative case study spanning from 2008 until 2018 of the World Business Council for Sustainable Development, an international organization that mobilizes 200 multi-national corporations to develop sustainable business solutions. Our sources of data included: interviews, documents, an ethnographic study and two personal accounts. We found

that social-ecological sustainability frameworks were utilized as a basis for collective strategy setting and communication. We identified 9 overlapping and emerging phases during which the PBF and the SDGs were utilized in collective efforts for global sustainability. Our findings show that Planetary Boundaries Framework was an effective framework for setting collective targets for business action based on science. Furthermore, the Sustainability Development Goals were utilized primarily for communication and evaluating current strategies.

Chapter 6 concluded the dissertation. First, I discussed the main contributions of each chapter. Second I synthesized all of the chapters into one figure. Third, I compiled avenues for research future. Fourth, I discussed the managerial implications of this work. Finally, I closed with one last thought.

SAMENVATTING

Deze dissertatie beoogt ons begrip betreffende duurzaamheidsmanagement te vergroten. Om de contributie van de dissertatie te positioneren, introduceer ik in hoofdstuk 1 een overzicht van bestaand onderzoek omtrent duurzaam ondernemen. Ik laat zien dat eerder onderzoek oproept tot een systeemperspectief dat de grenzen van de natuurlijke omgeving erkent. Ten gevolge van deze initiële oproepen in de literatuur wordt het bedrijfsniveau een belangrijk aandachtspunt. Meer recentelijk zijn er echter twee onderzoekstromen ontstaan om een holistisch begrip te bewerkstellingen van duurzaamheid: een paradox-perspectief en een systeemperspectief. Ik probeer een bijdrage te leveren aan de tweede stroom. Vervolgens introduceer ik een systeemperspectief van duurzaam ondernemen, inclusief de dimensies van schaal en inbedding. Ten slotte geef ik een schets van de rest van dissertatie, alsook de contributies van anderen.

Hoofdstuk 2 bespreekt de bestaande literatuur op het snijvlak van duurzaamheidsmanagement en een systeemperspectief. We hebben een systematische literatuurstudie uitgevoerd van de duurzaamheidsmanagementliteratuur van 1990 tot 2015, resulterend in 96 artikelen. Onze resultaten laten zien dat 54 procent van de artikelen gepubliceerd zijn in twee trans-disciplinaire wetenschappelijke tijdschriften, wat aantoont dat een systematische bandering van duurzaamheidsmanagement nog niet voorkomt in heersende wetenschappelijke management tijdschriften. Van de 96 artikelen hebben wij 5 theoretische kernconcepten van systeemdenken geïdentificeerd en beschreven, waaronder interconnecties, feedback, aanpassingscapaciteit, opkomst en zelforganisatie. Bevindingen tonen negen onderzoeksthema's, waaronder gedragsverandering, leiderschap, innovatie, industriële ecologie, sociaalecologische systemen, overgangsbeheer, overgangsbeheer, paradigmaverschuivingen en duurzaamheidseducatie. We sluiten het hoofdstuk af met een geïntegreerd 'cross-scale' raamwerk om toekomstig onderzoek te begeleiden.

Hoofdstuk 3 beargumenteerd dat de bestaande literatuur omtrent veerkracht in wetenschappelijke management tijdschriften zich primair richt op veerkracht op organisatieniveau, welke factoren de levensvatbaarheid van organisaties verhogen of verminderen in geval van bedreiging? Hoewel de focus op veerkracht van organisaties belangrijke theoretische contributies verstrekt, hangt veerkracht van organisaties ook af van de veerkracht van bredere sociaalecologische systemen waarin de organisatie is ingebed. Daarom beweren wij dat het 'cross-scale' overschrijden van de veerkracht op lange termijn niet goed gemanaged kan worden zonder een begrip van de feedbackeffecten over geneste systemen heen. Zo kan een nauwe kijk op het optimaliseren van organisatieveerkracht van het perspectief van één organisatie ten koste gaan van het sociaalecologische functioneren, en uiteindelijk de managementinspanning ondermijnen voor de overleving van de organisatie op lange termijn. In dit hoofdstuk integreren wij inzichten uit de natuurwetenschappen om organisatiewetenschappers te helpen om 'cross-scale' veerkracht te onderzoeken en acties van organisaties te conceptualiseren binnen en tussen temporale en ruimtelijke dynamieken om 'cross-scale' veerkracht te beheren. Op basis van documenten en een gepubliceerd voorbeeld van de palmolieproductie in Borneo wordt een genest systeemperspectief geïllustreerd van palmolie extractie, hetgeen zeer relevant is voor organisatiewetenschappers. Verder ontwikkelen wij proposities voor toekomstig onderzoek omtrent 'cross-scale' veerkracht.

Hoofdstuk 4 stelt dat organisatiestudies naar risico's baat kunnen hebben van inzichten uit de natuurwetenschappen omtrent systemische ecosysteemrisico's op planetaire schaal. We verstrekken een overzicht van de literatuur van organisatierisico's met betrekking tot de natuurlijke omgeving langs twee dimensies. Eerst onderzoeken wij of milieurisico's op een discreet moment in overweging worden genomen of dat risico's zich in de loop der tijd als een proces ontvouwen. Vervolgens overwegen we de richting van de bedreiging. Op basis van ons overzicht beargumenteren we dat de complexe rol van organisaties als collectieve bijdragers aan en ontvangers van systeemrisico's op planetair niveau nog steeds onderbelicht

blijft in organisatiestudies. We hebben een raamwerk opgesteld van drie fases om de feedback loops over organisaties en tussen sociaalecologische systemen te onderzoeken.

Hoofdstuk 5 adresseert de onderzoeksvraag: Hoe worden sociaalecologische duurzaamheidsraamwerken gebruikt als basis voor collectieve strategische planning en communicatie binnen een wereldwijde bedrijfsvereniging? We hebben een kwalitatieve case studie uitgevoerd tussen 2008 en 2018 van de World Business Council for Sustainable Development, een internationale organisatie welke 200 multinationale organisaties mobiliseert om duurzame bedrijfsoplossingen te ontwikkelen. Onze databronnen zijn: interviews, documenten, een etnografische studie en twee persoonlijke accounts. We vinden dat sociaalecologische duurzaamheidsraamwerken worden gebruikt als basis voor het opstellen van collectieve strategieën en communicatie. We identificeerden negen overlappende en opkomende fases waarin het Planetary Boundary Framework (PBF) en de Sustainable Development Goals (SDGs) werden gebruikt in collectieve inspanningen voor wereldwijde duurzaamheid. Onze bevindingen laten zien dat het PDF een effectief raamwerk is voor het vaststellen van collectieve doelen voor bedrijfsactiviteiten op basis van de wetenschap. Bovendien worden de SDGs voornamelijk gebruikt voor de communicatie en evaluatie van huidige strategieën.

Hoofdstuk 6 besluit het proefschrift. Eerst bespreek ik de belangrijkste bijdragen van elk hoofdstuk. Ten tweede worden alle hoofdstukken in één figuur samengevat. Ten derde stel ik de mogelijkheden voor toekomstig onderzoek voor. Ten vierde bespreek ik de praktische implicaties van dit werk. Ten slotte, sluit ik af met een laatste gedachte.

ABOUT THE AUTHOR

Amanda joined the Erasmus Research Institute of Management (ERIM) and started her PhD at Rotterdam School of Management (RSM) in July 2013. She also joined the Marie Curie Initial Training Network, Innovation for Sustainability (I4S) at the same time. As part of the I4S project, she collaborated with the World Business Council for Sustainable Development (WBCSD) where she joined the Redefining Value team and conducted field research for her PhD. During the last year of her PhD, Amanda was delighted to join the *Force for Positive Change* Initiative at RSM as an academic advisor.

Amanda's main research interest is at the intersection of sustainability management and social-ecological systems. She first became interested in sustainability while studying graphic media marketing during her bachelor's degree at Rochester Institute of Technology (RIT). RIT at the time was launching greening initiatives around campus. These initiatives caught Amanda's attention and led her to pursue a career in sustainability, although she still enjoys design.

During her PhD, she presented her work at various conferences. She presented at the Academy of Management (AOM) Annual Meeting (2014-2017) and the European Group for Organizational Scholars (EGOS) (2014-2016). She presented her work at several transdisplinary sustainability conferences including Resilience 2017 and the Program on Ecosystem Change and Society (PECS) 2015. She published the second chapter of her dissertation in the *Journal of Cleaner Production*.

Prior to her doctoral studies, Amanda lived in Paris, France for 3 years while pursuing a Master's degree and exploring different cultures. Before that she lived in Rochester, New York where she earned a Bachelor's degree and an MBA in Environmentally Sustainable Management at RIT. Amanda was born in a hospital in Auburn, New York on June 9, 1986. She grew up in the neighboring town of Skaneateles, New York where she spent the winters skating and the summers swimming in the blue beautiful lake.

Outside of conducting research, Amanda is passionate about spending time in nature while hiking. She also enjoys swimming, yoga and climbing. She has over 50 different plants that she enjoys to water and watch change with the seasons.

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Amanda joined the Erasmus Research Institute of Management (ERIM) and started her PhD at Rotterdam School of Management (RSM) in July 2013. She also joined the Marie Curie Initial Training Network, Innovation for Sustainability (I4S) at the same time. As part of the I4S project, she collaborated with the World Business Council for Sustainable Development (WBCSD) where she joined the Redefining Value team and conducted field research for her PhD. During the last year of her PhD, Amanda was delighted to join the *Force for Positive Change* Initiative at RSM as an academic advisor.

Amanda's main research interest is at the intersection of sustainability management and social-ecological systems. She first became interested in sustainability while studying graphic media marketing during her bachelor's degree at Rochester Institute of Technology (RIT). RIT at the time was launching greening initiatives around campus. These initiatives caught Amanda's attention and led her to pursue a career in sustainability, although she still enjoys design.

During her PhD, she presented her work at various conferences. She presented at the Academy of Management (AOM) Annual Meeting (2014-2017) and the European Group for Organizational Scholars (EGOS) (2014-2016). She presented her work at several transdisplinary sustainability conferences including Resilience 2017 and the Program on Ecosystem Change and Society (PECS) 2015. She published the second chapter of her dissertation in the *Journal of Cleaner Production*.

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