Doctoral theses at NTNU, 2023:342

Haley Knudson

Multilevel considerations for sustainability management

Doctoral thesis

NTNU
Norwegian University of Science and Technology
Thesis for the Degree of
Philosophiae Doctor
Faculty of Economics and Management
Department of International Business

NTNU
Norwegian University of
Science and Technology

Haley Knudson

Multilevel considerations for sustainability management

Thesis for the Degree of Philosophiae Doctor

Ålesund, October 2023

Norwegian University of Science and Technology
Faculty of Economics and Management
Department of International Business

NTNU
Norwegian University of
Science and Technology

NTNU
Norwegian University of Science and Technology

Thesis for the Degree of Philosophiae Doctor

Faculty of Economics and Management
Department of International Business

ISBN 978-82-326-7384-1 (printed ver.)
ISBN 978-82-326-7383-4 (electronic ver.)
ISSN 1503-8181 (printed ver.)
ISSN 2703-8084 (online ver.)

Doctoral theses at NTNU, 2023:342

Printed by NTNU Grafisk senter

Preface

This thesis is submitted to the Norwegian University of Science and Technology (NTNU) for partial fulfillment of the requirements for the degree of Philosophiae Doctor. The thesis contains a summary of the research and four original manuscripts.

The doctoral work has been performed at the Department of International Business (IIF) at NTNU in Ålesund, at the Faculty of Economics and Management (ØK). Professor Øivind Strand has been the main supervisor. Professor Annik Magerholm Fet and Professor Hans Solli Sæther have served as co-supervisors.

The PhD has been conducted as part of the TEFT-lab at IIF, funded by Sparebanken Møre. The TEFT-lab is a hub for research and development in service innovation, entrepreneurship, finance, and technology, and provided funding for three years of doctoral work. IIF provided the fourth year of funding.

Acknowledgements

I am overwhelmed with gratitude for the support received from my family, friends and colleagues throughout the years of my academic career and PhD thesis.

I would like to start by thanking my supervisor Professor Øivind Strand for his guidance and support throughout the PhD process. Øivind, your trust, encouragement and commitment to understanding my changing study scopes and research activities has allowed me to focus on the end goal, while also exploring new ambitions and views along the way.

I would also like to thank my co-supervisors Professor Annik Magerholm Fet and Professor Hans Solli-Sæther for their direction and views. Hans, thank you for helping me strive to find the simplest way to communicate my findings, even if I may not have always taken the straightforward route. Annik, thank you for your encouragement and inspiration, and for supporting me in my development as a researcher over the last eight years. Your dedication to making sustainability impact in industry is unparalleled, and you have given me the opportunity and motivation to try to do the same in my own career.

This study would not have been possible without the support I received from my colleagues throughout its course, both professionally and personally. Thank you to the Department of International Business in Ålesund and the HMS-group at the Department of Industrial Economics and Technology Management in Trondheim for making me feel inspired and supported no matter which city (or home office) I was in. Specifically, I must also thank John Eilif Hermansen, Paritosh Deshpande, Dina Aspen and Sigurd Vildåsen for their unequaled friendship. To find such amazing friends in your colleagues is truly a blessing.

Finally, there is no way that I would have reached this milestone without the support of my family and friends. Jacob, your patience and grounding give me the confidence to search for new ways to be inspired and to challenge the status quo. You motivate me to do better and stay committed to the people we both want to be. Mom, Dad and Dayne, thank you for your constant support, no matter the distance between us. Thank you for nurturing me into a curious and passionate person who is not afraid of hard work and still hopes to ‘change the world’ in her own way.

Summary

This thesis investigates how the concept of business models for sustainability (BMfS) supports and enables sustainability management in organizations. Another premise surrounds how the concept can bridge organizational and societal system levels for wider sustainability impact within and by organizations. Its findings show that strong and holistic sustainability performance requires a specific perspective to the business model (BM). Its activities must be considered in relation to the multiple layers of society, multiple sections of its value chain, and multiple dimensions of sustainable development. This thesis appreciates the novelty of BMfS research, distinguishes research and practice gaps in the complex sustainability management field, and highlights the limited inclusion of sustainability in existing organizational and management theories. The objective therefore is to contribute to a multilevel theory of sustainability management that outlines the expansive, intertwined, and often contradictory aspects embedded in the transition to more sustainable business practices. It uses the BMfS and its context for cognitive conceptual grounding.

Complementing the BMfS research stream, the study presents the development of a conceptual framework known as the ***Cap****acity building in* ***S****ustainability and* ***E****nvironmental* ***M****anagement (CapSEM)* model. The model categorizes sustainability and environmental management methods and tools across four organizational system levels: Level 1 – production processes, Level 2 – products and value chains, Level 3 – organization and management, and Level 4 – larger systems such as macro level society or an industry sector. Its conceptualization supports the development of knowledge in organizations by simultaneously providing an entry point, common language and map to environmental and sustainability management approaches and tools. Organizations can engage with sustainability aspects within and across each of its systems levels for incorporation into their BM, linking their operational practices with their accelerating sustainability strategy.

Identifying the theoretical perspectives and approaches needed to tackle the challenges of implementing sustainability management in organizations, the study has been guided by and addresses three research questions (RQs):

> **RQ 1:** *Which perspectives and tools can help close the design-implementation gap between ideation and implementation of BMfS?*

RQ 2: *How can the concept of BMfS help link organization and societal system levels of sustainability?*

RQ 3: *How do the identified perspectives contribute to a multilevel theory of sustainability management*?

This thesis is of a theoretical nature and is the result of a combination of diverse qualitative and analytical research activities across the BMfS field and the CapSEM model. Empirical data was collected through the application and development of the CapSEM model in academia-industry contexts. These contexts include the CapSEM model's namesake international knowledge building project, in which I served as coordinator and facilitator, the Business Hub for Sustainability (BH4S) at NTNU Ålesund, and other training and engagement sessions with industry. Each was an arena for observation of the challenges in the process of developing and implementing sustainability knowledge in organizations. It is these challenges, in combination with the identification of perspectives that support knowledge uptake, that guide its suggestion of using BMfS as a cognitive frame to encourage sustainable business development from a multilevel approach. The four appended papers, and the experiences gathered throughout their elaboration, have exposed the breadth of levels and dimensions required to pragmatically address sustainability management. The research process has informed the complex selection of practical and theoretical perspectives necessary for the multilevel and multidirectional approach to be strived for by organizations in their sustainability journey. The result is a contribution to multilevel sustainability management theory through the linking of conceptual frameworks.

Based on the research results, the contribution of this thesis is three-fold. First, and in answer to RQ 1, the development and application of the CapSEM model provides insight for organizations to build knowledge and close the design-implementation gap in BMfS (**Paper 1**). Further, analysis of the transdisciplinary (TD) aspects of the model, and its application in the CapSEM project, demonstrate its grounding in the recognition of the multilevel context of sustainability, and the importance of stakeholder engagement for integrated sustainability management (**Paper 2**).

Second, this thesis addresses RQ 2 through the application of a mediating perspective to BMfS in which the BM is a facilitative layer within two systems – between both the organization's operational activities and sustainability strategy, and the organization as an entity and the multilevel context in which it operates. Both views are systems perspectives that identify the

elements and their interactions within the organizational system and within the societal system, respectively. Recognizing the value provided by BMfS archetype categorization, the thesis also recognizes the need for more holistic archetypes that incorporate wider stakeholder perspectives to guide organizations and customers, and that demonstrate the complexity of BMfS (**Paper 3**). Institutional influences on sustainability management and BMfS strategies are also investigated (**Paper 4**) and show the complex web of multilevel and transitioning expectations and logics that impact an organization in its quest toward sustainability.

By linking the mediating perspective of BMfS and sustainability through the CapSEM model to discussions of existing organizational theories, the thesis makes its third contribution. It outlines a theoretical contribution to multilevel sustainability management built on the following foundations:

- Changing the perspective from the firm as the focal unit to the value network as the focal unit
- Recognizing that stakeholder management is not an add-on to existing organizational mandates and licenses to operate, but that long-term organizational sustainability requires the firm and its stakeholders be an integrated unit
- Using a BMfS to conceptualize organizational needs and objectives across levels of the inter-institutional system, and to map the ways certain mechanisms will support or hinder an organization's long-term sustainability goals
- The CapSEM model framework is one approach to support an organization in its ability to:
  - position itself in such multilevel system
  - practically identify and apply environmental and sustainability tools and methods to improve and report upon its sustainability performance
  - find a common vocabulary and conceptualization to discuss interwoven sustainability challenges with its stakeholders

In conjunction with these findings, the thesis finally asserts that though integrating existing management theories into a multilevel approach to sustainability management is valuable, a theory that sufficiently captures the complexity and urgency of sustainability cannot be a collection of their parts. While contributions to such approach were made in this study, more research is still required to explore and interpret the multiple systems in which organizations operate, and the tensions and value conflicts that result.

Table of Contents

List of Figures

List of Tables

Acronyms

BM	Business model
BMfS	Business model for sustainability
BMC	Business model canvas
BMI	Business model innovation
BMIfS	Business model innovation for sustainability
CSR	Corporate social responsibility
ESG	Environmental, social, and governance
EU	European Union
GRI	Global Reporting Initiative
NRBV	Natural-resource-based view
RBV	Resource-based view
SD	Sustainable development
SDGs	Sustainable Development Goals
TBL	Triple bottom line
TLBMC	Triple layer business model canvas
WBCSD	World Business Council for Sustainable Development

List of appended papers

Paper		Status and ranking*
1	Fet, A.M. & Knudson, H. (2021a). An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model). *Sustainability*, 13.	Published 2021 (Level 1 journal)
2	Fet, A.M. & Knudson, H. (2021b). 'Transdisciplinarity in sustainability management' in Keitsch, M.M. & Vermuelen, W.J.V. (eds.) Transdisciplinarity for sustainability: Aligning diverse practices, Routledge/ ISDRS Series in Sustainable Development Research, Routledge, pp. 93-117.	Published 2020 (Level 2 book)
3	Knudson, H. & Keitsch, M.M. (2023). 'Helping business contribute to a sustainability transition: Archetypes of business models for sustainability' in Fet, A.M. (ed.) Business transitions: A pathway to sustainability, Springer.	Published 2023 (Level 1 book)
4	Knudson, H. (Conference paper). Examining institutional influences and values in sustainability management.	Presented at NORSI Conference, April 2022

*Rankings from the Norwegian publications list by the Norwegian Social Science Data Services (NSD)

1 Introduction

Organizations face challenges when developing and implementing sustainability strategies within their business models. This thesis presents guiding principles and theoretical considerations for sustainability management across a multilevel context. It provides conceptual and theoretical analysis, along with reflections integral to improving the sustainability of organizations. Further, it contributes to the research field by strengthening the understanding of the multilevel context in which organizations operate and sustainability management decisions must be made.

1.1 Background and need for research

The dangers of climate change and the responsibility of organizations for their effects on the environment and society have brought issues of sustainability into the business discussion. Sustainable development (SD) requires the combination of several complex systems including the global economy, social interactions, earth systems, and governance (Sachs, 2015). It is a normative concept that requires broad and multidimensional conceptualization.

Global frameworks, such as Agenda 2030 and the United Nations (UN) Sustainable Development Goals (SDGs) (United Nations General Assembly, 2015), provide parameters for its achievement and help to conceptualize the multiple dimensions and interconnections inherent in SD. The SDGs and their objectives interact, creating synergies and trade-offs that can only be addressed through holistic and multidisciplinary approaches (Lusseau and Mancini, 2019; Pradhan, 2019; Pradhan et al., 2017). Though they prescribe targets for national contribution, the SDGs cannot be achieved without the commitment and contribution of the private sector and societal organizations (e.g., United Nations 2020, 2021).

The European Union's (EU's) taxonomy for environmental activities and other Environmental, social, and governance (ESG) initiatives provide links between society level SD objectives and organizational level contribution. Extensive work by international sustainability organizations, such as the UN Global Compact, Global Reporting Initiative (GRI), and World Business Council for Sustainable Development (WBCSD), provide guiding material for organizations to realize SDG market opportunities and contribute to meeting their targets. Still, principles of profit maximization and optimized efficiency guide the global market. This makes the

transition to SD about more than reaching prescribed goals and targets, but also transforming the values and perspectives that guide business and development. World events like the 2008 financial crisis, impacts of climate change, and the Covid 19 pandemic provide clear evidence of the effect the global economy has on all of us, and of our urgent need to solve global sustainability challenges. This thesis therefore investigates aspects of supporting and enabling businesses and organizations to contribute to sustainability at the macro level. Figure 1 presents the multilevel societal system that frames its analysis – from the macro, or system, level of institutions and society, to the meso level of inter-organizational and organizational domains, and the micro level of individuals.

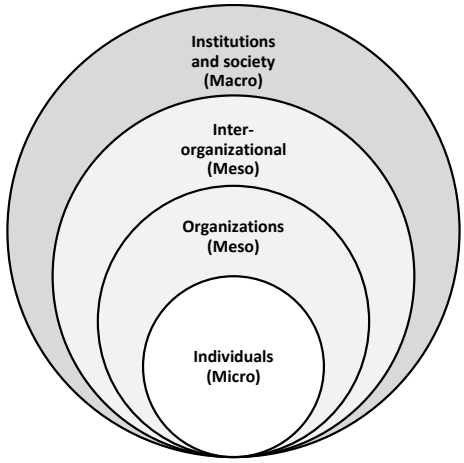


Figure 1: Levels of the societal system
(based on Dopfer et al. (2004); Friedland and Alford (1991))

SD, and in turn, corporate sustainability and sustainability management, are based at the intersection of three main principles: environmental integrity, social equity, and economic prosperity (Bansal, 2002). They are multilevel concepts that link organizations and their activities to system level objectives of the society and natural environment (Schwartz and Carroll, 2008; Whiteman et al., 2013). But more research is needed to understand how SD is operationalized at the organizational level (Bansal, 2005), especially across diverse and dynamic organizational contexts (Silvestre et al., 2022). Further, the integration of sustainability aspects and values into organizations remains at a disappointing level, based

mainly on a lack of strategic orientation in the implementation of sustainability practices (Baumgartner and Rauter, 2017).

Sustainability management links the macro level concept of SD with the meso level and is therefore the grounding field of this thesis. It is defined as "the formulation, implementation, and evaluation of both environmental and socioeconomic sustainability-related decisions and actions" (Starik and Kanashiro 2013, p.12). Often used synonymously with corporate sustainability or corporate sustainable development (Schwartz and Carroll, 2008), it concerns the management of environmental, social, and economic sustainability issues within an organization, and the alignment of these activities with the organization's strategy and business goals (Schaltegger, 2013). Traditional organizational and management theories do not sufficiently capture the complexity of sustainability but have been applied to inform and clarify the relationships between organizations and each of the levels of society depicted in Figure 1 (Starik and Kanashiro, 2020, 2013).

To bring this complex topic to a workable scale, *business models for sustainability (BMfS)* are used as a representative concept to frame and discuss organizations' approaches to improving their sustainability performance and management strategies. A business model (BM), from the traditional management perspective, is a reflection of a firm's strategy (Casadesus-Masanell and Ricart, 2010; Richardson, 2008; Seddon et al., 2004; Shafer et al., 2005). It provides the organizational and financial architecture of a business and its understanding of its customers and their needs (Teece, 2010). BMfS are BMs that contribute to environmental, social, and economic dimensions of sustainability to deliver value to their customers and their stakeholders, with the perspective of long-term resilience for society and the environment (Geissdoerfer et al., 2018).

The BM, and BMfS, can also be understood as existing as a layer between organization strategy and operational activities, as introduced in Figure 2. BMs drive strategy, and provide the logic and structure to how strategy is adapted, achieved, and communicated within and beyond organizational boundaries (Carayannis et al., 2015; Lüdeke-Freund et al., 2019; Osterwalder, 2004; Rauter et al., 2017, 2017). It is this relationship that explains that BMs, and change within them, can support the strategic aims of organizations, and originally brought the attention of sustainability management researchers to the BM concept (Schaltegger et al., 2016a). The complexity of sustainability further requires that strategy, BM structure, and operational

activities together support value creation across environmental, social, and economic value dimensions.

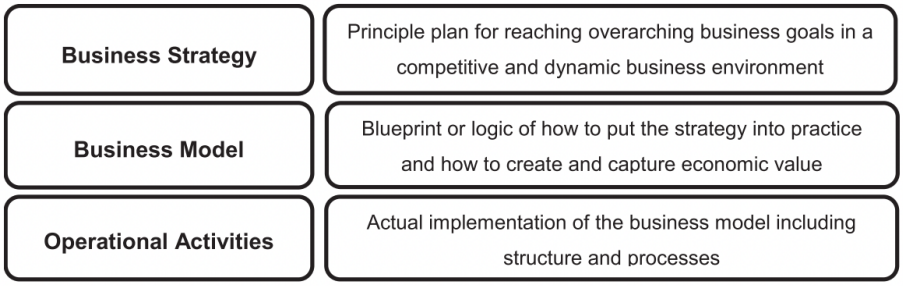


Figure 2: Relationship between layers of operational activities, the business model, and strategy (Rauter et al., 2017)

Challenges in the implementation of or adaptation to BMfS include:

- balancing tensions between environmental, economic, and social objectives;
- redefining organizational logics and established norms and structures;
- redistributing resources to build sustainability capacity;
- establishing systems for engaging with stakeholders; and
- finding appropriate and helpful tools to engage in business modelling and the development of sustainability strategy (Evans et al., 2017).

Due to these challenges, a 'design-implementation gap' has been identified between ideation and implementation of BMfS, and the innovations and strategy changes needed for their implementation (Geissdoerfer et al., 2018). The process of creating or changing a BM for sustainability requires an organization to search for and implement new ideas and knowledge into their BM – the question remains, however, how best to go about it.

Addressing SD in organizations requires complex, subjective, and multilevel approaches. Organizations need clear guidelines but must also be able to perform their own contextual analyses to ideate and situate possible innovations and strategies that improve their sustainability performance. A BMfS therefore depends on an organization's capacity to understand its context, including the interconnections between its activities, actors, and environmental, social, and economic dimensions, in addition to the alignment of its operations

with its strategy and definition of priorities. Insufficient recognition of the multiple levels and often competing objectives of sustainability management prevents the holistic integration of sustainability into organizations.

Summarized in a focused special issue, Dentchev et al. (2018) assert that future research on BMfS is needed across many streams including:

- better conceptual boundaries for BMfS;
- increased theoretical development for understanding the drivers, processes, and outcomes of BMfS;
- more sophisticated empirical methods to research BMfS;
- inclusion of the role of institutions and government in the development, diffusion, and success of BMfS across different contexts;
- further examination of the interactions between existing BMs and BMfS in e.g., one industry sector or one company; and
- strengthened dialogue with intersecting research communities, such as innovation and entrepreneurship scholars, and "traditional" BM researchers.

Combining these streams with identified organizational level challenges and the design-implementation gap, this thesis takes an organizational and strategic theory lens to sustainability management to contribute to the investigation of ways to help organizations develop a BMfS. This includes strengthening tools for implementation and knowledge-building, as well as improved theoretical contributions with roots in management and systems thinking.

1.2 Objective and research questions

This thesis set out to investigate how the concept of BMfS could support and enable sustainability principles in organizations. Recognizing growing pressures to increase environmental and social sustainability in organizations, and the fragmented, ever-developing research in the field, it aims to provide guidance to both organizations and researchers as they continue their sustainability journey.

Another premise of exploration surrounds how the BM, a common framework used by companies and in organizational studies alike, could serve as a bridge between organizational

and societal system levels for wider sustainability impact within and by organizations. Its findings show that holistic sustainability implementation requires a specific perspective to the business model, in which its activities are connected to the multiple layers of society, multiple sections of its value chain, and multiple dimensions of sustainability. It is not sufficient to look at the BM from only the organization's perspective or as only an architecture of value creating components. While the architectural perspective is crucial, the organization must also position itself outside of its boundaries to reflect upon and evaluate the needs of its stakeholders, the institutional influences it is subject to, and its long-term responsibility.

The motivations and methods for sustainability management and increasing sustainability performance depend on characteristics of the organization. Therefore, the investigation of contextual factors and the organizational environment is important for strategy development and implementation within the BM (Silvestre et al., 2022). Just as one would not begin designing and building a bridge without surveying both sides, an organization must take account of its position within the dynamic network of interactions between its actors and activities. *The objective is therefore to contribute to a multilevel theory of sustainability management that uses the BMfS and its context for cognitive conceptual grounding.*

To meet this objective and identify theoretical perspectives and approaches to address the challenges of sustainability management within organizations, this thesis is guided by three research questions (RQs):

> **RQ 1:** *Which perspectives and tools can help close the design-implementation gap between ideation and implementation of BMfS?*
>
> **RQ 2**: *How can the concept of BMfS help link organization and societal system levels of sustainability?*
>
> **RQ 3:** *How do the identified perspectives contribute to a multilevel theory of sustainability management*?

1.3 Research motivation and design

The thesis applies a qualitative methodology to clarify and conceptualize sustainability management using BMfS. It provides a theoretical contribution to a multilevel theory for sustainability management, while advancing the current knowledge in the fragmented sustainability management field.

My identification of common organizational challenges for the strategic implementation of BMfS was compounded by tensions between environmental, social, and economic dimensions, differing values, and complex organizational environments that cross multiple levels of societal systems. I was intrigued by the possibility for BMfS to serve as a cognitive frame for organizations to investigate their prospective pathways to implementing strategic sustainability strategies and activities. Such requires them to map impacts across the short- and long-term, across operational activities, in line with stakeholder values, and while recognizing tensions and challenges likely to occur.

1.3.1 The CapSEM project and model

These interests stemmed from my involvement in an international knowledge building project, rightfully named, ***Cap****acity building in* ***S****ustainability and* ***E****nvironmental* ***M****anagement (CapSEM).* The CapSEM project was an international project funded by the Erasmus+ program of the European Union between universities and stakeholders in Norway, Portugal, the Netherlands, Uganda, India, and Nepal. The main goal of the project was to build knowledge, develop university curriculum, and share experiences between partners in Europe and the rest of the world. The project ran from October 2016 – October 2019, in which I served as project coordinator.

Through engagement with diverse stakeholders, the project resulted in the implementation, refinement, and publishing of the *CapSEM model*, presented in Figure 3. The CapSEM model is a conceptual framework that categorizes sustainability and environmental management methods and tools across four levels: Level 1 – production processes, Level 2 – product and value chains, Level 3 – organization and management, and Level 4 – larger systems such as macro level society or an industry sector.

My role as CapSEM project coordinator was instrumental in directing the progression of my PhD research process. My roles included organization of and engagement in project activities such as teaching and training, as well as administration, communication, and reporting. These activities provided an arena for qualitive observation and exposed the range of difficulties associated with conceptualizing and implementing sustainability – beginning with the impossibility of agreeing on a definition of 'sustainability' across diverse contexts with varied needs. It seemed that the way the model outlined the different organizational system levels,

from production processes, products and value chains to organizational management systems and macro level influences and needs, provided users a guide, or map, to help situate their understanding of their place within the system.

1.3.2 A framework to meet practitioner and academic challenges

The study therefore investigates the journey of moving towards sustainability in a BM through the CapSEM model. Links between them are analyzed from practical and theoretical perspectives. Such exposes the expanse of variables and dimensions required to pragmatically address sustainability in diverse organizational contexts. The development and application of the CapSEM model helps organizations situate themselves within the complex context of SD and exposes and explicates the different systems in which organizations are part. BMfS is used as both a representative concept, characterized by the value proposition, value creation and delivery, and value capture ontology, and as a conceptual framework that shows its mediating ability within the organization (between operational activities and organizational strategy), and beyond the organization (with value network actors and wider society).

Empirical data was collected through the application and development of the CapSEM model in academic-industry contexts. While the educational aspect is not a main topic of this thesis, it has primed the observation of the challenges in developing sustainability knowledge. It is these challenges, in combination with the identification of perspectives that support knowledge uptake, that guide its proposal and analysis of using BMfS as a cognitive frame to encourage sustainable business development from a multilevel approach. Research has therefore followed an evolving process, in which relevant phenomena and existing theories across BMfS and the CapSEM model were investigated for their ability to describe and explain the relationships between concepts. The result has informed contributions to the field of sustainability management and the advancement of a multilevel theory. Table 1 summarizes the thesis topic, aims, methods, and findings.

1.4 Scope

The study investigates the process of improving the sustainability performance of an organization's BM. Concerning its scope, a few clarifications should therefore be noted. First, different perceptions of BMs and BMfS situate the concepts within the organizational, inter-

organizational, or even macro level. Such depends on the view of BMs and BMfS as static architectures versus systems that change, or as concepts situated within versus beyond organizational boundaries. In this study the BM and BMfS are seen as concepts that help organizations conceptualize their operational activities (on the organizational level), but that must simultaneously be viewed as *systems* that depend on and interact with other value chain stakeholders. This understanding therefore situates the cognitive frame of BMs and BMfS on the organizational level, while considering inter-organizational and macro level factors.

Next, although the strategies and approaches of managers to sustainability in their organizations are an important consideration of this thesis, characteristics of the individual (at the micro level) are not within its scope. The focus of the thesis is therefore on macro and meso level concepts that help explain the relationships between organizations and society, while recognizing that individual level characteristics are of great importance to and influence the organization.

A final note concerns the use of terms to describe groups of people on the organizational level. In its application of an organizational theory lens, the thesis sometimes uses the term 'firm' because of the strategic management field's focus on for-profit organizations. 'Organization' is used broadly, however, to refer to groups with varying purposes such as NGOs, government bodies, and universities, in addition to companies and firms, all of which can benefit from the multilevel perspectives prescribed by this thesis.

1.5 Thesis structure

The thesis is structured as follows. Chapter 1 establishes the background, objective, and RQs that have guided the thesis. The need for the study is highlighted through identified gaps in the developing BMfS field and challenges in their practical implementation, along with the call for more management research that links research and practice and meso and macro levels (Molina-Azorín et al., 2019). Chapter 2 presents the study's conceptual and theoretical foundation across fields of SD, sustainability management, and BMfS. Theoretical foundations for these concepts are introduced, namely, systems perspectives to sustainability and organizational management theories regularly applied and considered in the sustainability management field. Chapter 2 continues by highlighting the sustainability-related philosophies of these theories, and by exposing their individual limitations in terms of a holistic multilevel

theory. With the conceptual and theoretical scaffolding established, Chapter 3 provides an overview of the research approach. Chapter 4 details the overall research process and the methods applied in the appended papers through the final analysis performed within this document. It continues by summarizing the findings from Papers 1–4 and contextualizing them within the thesis' scope in answer to the RQs. The findings and their contributions are discussed in Chapter 5 as input to a multilevel theory for sustainability management applying the CapSEM model and system perspective of BMfS. Chapter 6 concludes the thesis.

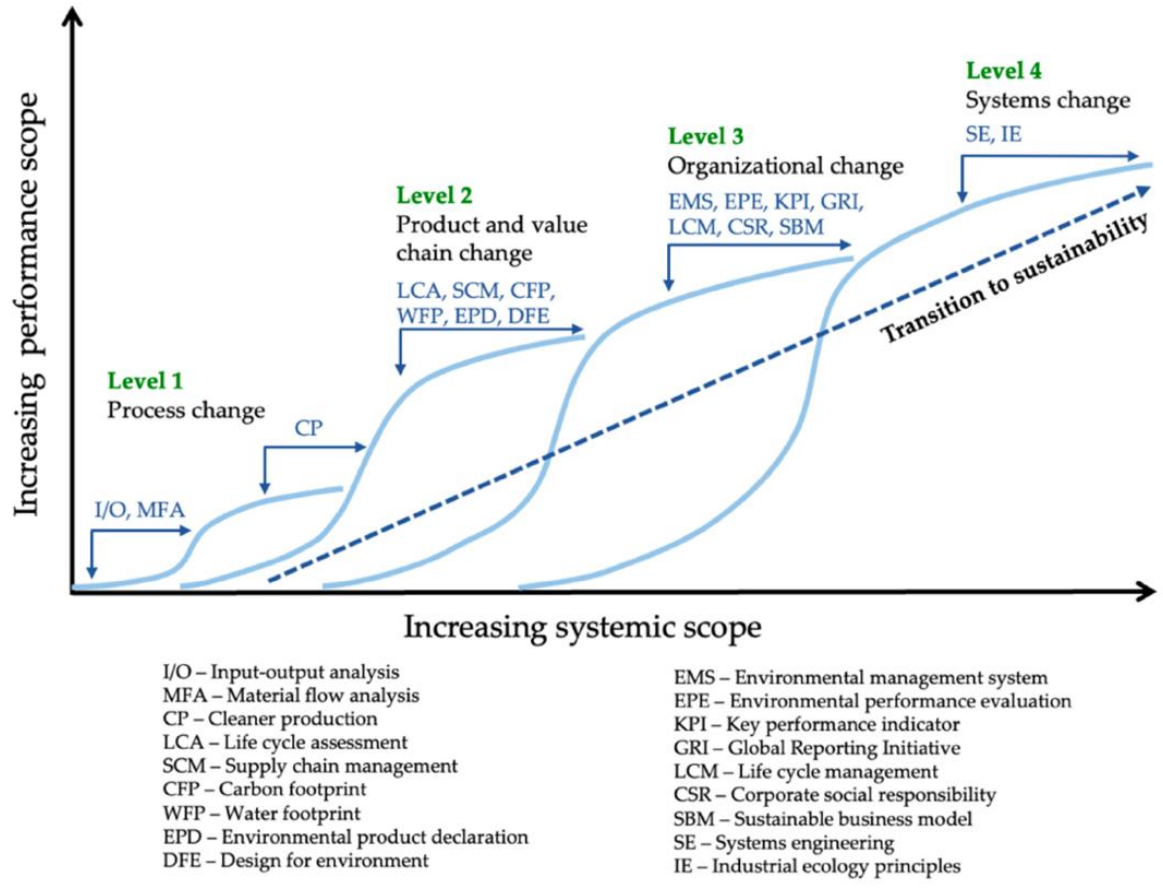


Figure 3: The CapSEM model
(Fet and Knudson, 2021a)

Table 1: Overview of the thesis

Research focus	Aims	Theory	Findings

To address the challenges in the implementation or adaptation of BMfS to support holistic sustainability in organizations	Find perspectives and tools to help close the design-implementation gap between ideation and implementation of BMfS (RQ1)
	
	Investigate how the concept of BMfS can help link organization and societal system levels of sustainability (RQ2)
	
	Contribute to a multilevel theory of sustainability management (RQ3)
		• Sustainable development
		• Sustainability management
		• Business models for sustainability
		  – Mediating perspective
		  – Activity system perspective
		• Sustainable value
		• Systems perspectives of sustainability
		• Organizational management theories, incl:
		  – Stakeholder theory
		  – Transdisciplinarity
		  – Institutional theory
		• Environmental management methods and tools
		• Stakeholder engagement
		• Sustainability philosophies & limitations of organizational management theories
			The CapSEM model provides a framework for organizations that outlines layers of the societal system, value chain network and stakeholders, and environmental, social & economic dimensions.
			
			Strong and holistic sustainability performance requires a specific perspective to the business model, in which its activities are connected to the multiple layers of society, multiple sections of its value chain, and multiple dimensions of sustainability.
			
			A multilevel contribution to sustainability management theory includes:
			• Changing the perspective from the firm as the focal unit to the value network as the focal unit
			• Incorporating stakeholder management not as an add-on, but viewing the firm and its stakeholders as an integrated unit
			• Using a BMfS to conceptualize organizational needs and objectives across levels of the inter-institutional system, and to map the ways certain mechanisms will support or hinder their long-term sustainability goals.
			• The CapSEM model framework supports an organization to:
			  – position itself in such multilevel system;
			  – practically identify and apply environmental and sustainability tools and methods to improve and report upon its sustainability performance; and
			  – find a common vocabulary and conceptualization to discuss interwoven sustainability challenges with its stakeholders.

Objective		**Methods**	

To contribute to a multilevel theory of sustainability management that uses BMfS and their contexts for cognitive conceptual grounding		• Literature review
		• Participant observation
		  – CapSEM project
		  – Industry engagement
		  – Case observations
		• Framework application and development
		• Conceptual & theoretical analysis	

2 Theoretical perspectives

This chapter reviews the literature and perspectives that underpin research on sustainability management including SD (at the macro level), and sustainability and BMfS (at the meso level). After a presentation of overarching concepts, organizational and management theories commonly applied in the corporate sustainability domain are presented and assessed for their ability to support the development of a multilevel theory of sustainability management as prescribed by this thesis.

2.1 Sustainable development

SD is a normative concept that provides a holistic vision and goals for a what a good society should be, i.e., economically prosperous, socially inclusive, environmentally sustainable, and well governed (Sachs 2015, p.4). It is also a 'wicked' challenge characterized by complex interconnections between its systems, subjective consideration of a wide array of stakeholder needs and values, and multiple scales of geography and time (e.g., Brandt et al., 2013; Pryshlakivsky and Searcy, 2013). It is defined most widely as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987).

Conceptually, SD is divided into three interlinked dimensions of environment, society, and economy, regularly referred to as 'the triple bottom line' (TBL) (Elkington, 2018, 1998). These dimensions are often represented as separated pillars, or as a Venn diagram with partially overlapping dimensions. Recognizing that human activity depends on the earth system, however, the interconnected nature of sustainability requires the dimensions be conceptualized as a nested system in which the environment is the foundation and boundary for all dimensions (Adams, 2006; Giddings et al., 2002; Griggs et al., 2013; Pryshlakivsky and Searcy, 2013). This thesis therefore depends on the following definition of sustainable development as its foundation: "development that meets the needs of the present while safeguarding Earth's life-support system, on which the welfare of current and future generations depends" (Griggs et al., 2013). Such redefinition situates human activity within earth's planetary boundaries (Rockström et al., 2009), which serve as the ultimate determinant for long-term success.

2.2 Corporate sustainability and sustainability management

There are many frameworks and approaches for the integration of sustainability principles and objectives into the organization. The process and its meaning has been studied from angles including, but not limited to, strategy (e.g., Baumgartner and Ebner 2010; Baumgartner and Rauter 2017), ethics and responsibility (e.g., Carroll and Laasch 2020; Schaltegger and Burritt 2018), and stakeholder management (e.g., Freeman 2010). Organizational sustainability concepts include corporate social responsibility (CSR), corporate sustainability, sustainability management, corporate environmental management, business ethics, stakeholder management, and responsible management, to name a few, and have overlapping and evolving boundaries. The development and overlap of concepts has transformed in relation to progress in research and policy, and researchers have traced the ebb and flow of the field (Bansal, 2005; Carroll, 2015; Carroll and Laasch, 2020; Meuer et al., 2020; Sánchez-Teba et al., 2021; Schwartz and Carroll, 2008; van Marrewijk, 2003). Some concepts focus more on the societal dimension, e.g., CSR, stakeholder management, and business ethics, while others focus more on environmental strategies, e.g., environmental management. Further, they range from philanthropic activities to strong integrated sustainability strategies.

For this thesis, *sustainability management* is used to refer to approaches and strategies for improving the sustainability performance of organizations. Sustainability management "describes an activity of managing sustainability issues in organizations" and "covers all systematic activities to measure, analyze, improve and communicate economic, social, and environmental aspects of a company" (Schaltegger 2013, p.2384). *Corporate sustainability*, defined as "company activities - voluntary by definition - demonstrating the inclusion of social and environmental concerns in business operations and in interactions with stakeholders" (van Marrewijk 2003, p.102), is the domain under which sustainability management falls and is therefore sometimes used synonymously in the text. Both terms are used to describe a strategic and coordinated approach to integrating sustainability into organization systems and activities and differ from fragmented approaches of uncoordinated sustainability activities.

Sustainability management activities therefore concern managing environmental, social, and economic aspects, engaging with stakeholders, setting strategic objectives and goals for improvement, and sustainability monitoring, reporting, and communication. The next sections present the important corporate sustainability concepts of *sustainable value*, *sustainability*

strategy, and *the business case perspective to sustainability* to guide further engagement with the thesis and its findings.

2.2.1 Sustainable value

Value is a central concept in research for sustainability management and BMfS. A more comprehensive understanding of value and its forms is needed to further promote sustainability in a business context (Yang et al., 2017a). Values can be defined as "individual and collective trans-situational conceptions of desirable behaviors, objectives and ideals that serve to guide or valuate practice" (Askeland et al., 2020, p.3). They are multifaceted and have many different interpretations debated widely across research fields, and at the levels of society, the organization, and the individual (Lepak et al., 2007). *Value creation* is a fundamental concept within both organizational theory and management research, and traditionally relates to the relative amount of value realized subjectively by the individual, organization, or society under study in relation to the willingness to exchange a monetary amount for the value received (Lepak et al., 2007).

In terms of sustainability, this value comes in multiple forms that shape and form organizational strategy and business models. This requires the recognition of the resource creating potential of, for example, knowledge building, innovation, and environmental and social growth for an organization's value capture (Lepak et al., 2007). Engagement with stakeholders, then, is an important part of identifying areas for and types of mutual value creation for sustainability (Freudenreich et al., 2020; Hart et al., 1993; Stubbs and Cocklin, 2008). The identification of environmental and social value forms may therefore help an organization distinguish areas where sustainable value is currently missed (e.g., waste heat or materials that could become inputs), destroyed (e.g., pollution, bad working conditions), absent (e.g., competence needed but not present in employees), or in surplus (e.g., wasted resources, underutilized employees) (Yang et al., 2017a).

Within the current market, these value forms continue, mainly, to be equated to financial means through, for example, increased productivity due to investment in human resources, reduced cost from more efficient resource use, or tapping underutilized employee pools. Areas where environmental or social value is being missed or destroyed therefore pose ideal areas for future

business model development and direction toward sustainability (Bocken et al., 2015; Yang et al., 2017a, 2017b).

2.2.2 Sustainability strategy

Strategy concerns the purpose of an organization, and the way that purpose is achieved through its resources and activities. Integrating sustainability into BMs depends on the incorporation of sustainability principles into the development and implementation of organization level strategy (Rauter et al., 2017).

Strategy can be divided into three components: the *strategy process*, the development and 'how, who, and when' of the strategy, the *strategy content*, the result of strategic activities, and the *strategy context*, the conditions surrounding strategic activities (de Wit and Meyer, 2010). The strategy therefore concerns different phases, i.e., a plan for achieving strategic objectives, as well as the implementation and outcome of this plan. An organization's sustainability strategy, then, helps drive the strategy process and content toward sustainability objectives within the strategy context.

Baumgartner and Rauter (2017) highlight important aspects when designing the content of sustainability strategies including the consideration of for whom the activities are to benefit and create value, and how to appropriately define sustainability and goals to achieve it within the organization. In terms of benefit, they assert the need to identify which system level the social or environmental value will impact, e.g., social value, for actors within the organization and/or in its wider societal context, and environmental value within the organization through e.g., efficiency, but also for the biosphere as a whole. Further, since the needs of stakeholders and the environment and regulatory requirements change over time and depending on location, a clearly defined sustainability strategy with well-defined and reflexive goals is also essential (Baumgartner and Rauter, 2017). To define these goals, an organization must assess its economic, environmental, and social sustainability aspects, and identify those which are most material to its strategy and context. Then, when developing indicators for performance of its sustainability strategy, it must consider the processes within the organization, as well the effect of those processes on environmental and social value creation at the societal level (Rauter et al., 2017). Table 2 presents a list of these aspects in relation to sustainability management.

In addition to the identification of sustainability aspects, an organization must consider normative, strategic, and operational levels of management within its sustainability strategy. The strategy process then concerns normative aspects of deciding the values and philosophy of the organization and its culture, the strategic directions of the BM activities toward its long-term objectives, and operational integration of sustainability through enhanced employee capabilities (Baumgartner and Rauter, 2017). Though the individual characteristics of managers are outside the scope of this thesis, their influence on the creation of sustainability management strategies must be highlighted. In addition to market, regulatory, and customer pressures, conditions for organizations to increase their sustainability performance include the individual concern of the manager for sustainability and the alignment of this concern with organizational values (Bansal, 2003; Bansal and Roth, 2000).

Table 2: Economic, environmental, and social aspects for sustainability management
(based on Baumgartner and Ebner (2010))

Economic aspects	**Environmental aspects**	**Social aspects**	
		Internal	*External*
• Innovation and technology • Collaboration • Knowledge management • Clear management processes related to sustainability • Purchase considerations • Sustainability reporting	• Resources (material, energy) including recycling • Emissions to air • Emissions to water • Emissions to the ground • Waste and hazardous waste • Biodiversity • Environmental issues of the product over the whole life cycle	• Corporate governance, including transparency • Motivation and incentives • Health and safety • Development of human capital for sustainability	• Ethical behavior and human rights • No controversial activities • No corruption • Corporate citizenship

While this thesis positively supports integrated approaches to sustainability with environmental and social needs in the organizational core along with economic viability, strategic approaches range broadly. The maturity or performance level of an organization's sustainability strategy can be categorized along a continuum ranging from weak/defensive sustainability, in response to external pressures and to avoid risk of noncompliance, to strong/proactive sustainability, which integrates long-term perspectives of regeneration and stakeholder engagement into the driving logic of the organization (e.g., Landrum, 2018). Based on an organization's strategic objective for its sustainability strategy and consideration of different sustainability aspects, Baumgartner and Ebner (2010) characterize four main types of strategy: introverted, focused on risk mitigation and meeting regulations and standards; extroverted, focused on gaining

credibility and legitimacy through its sustainability-related activities; conservative, focused on eco-efficiency and cleaner production; and, visionary, a holistic sustainability strategy, integrating all sustainability dimensions and directed at organizational and system level impact.

2.2.3 The business case for sustainability

Based on its span across levels, sustainability management is embedded with tensions between interdependent but often divergent sustainability objectives that result from an organization's role to remain financially viable while also contributing to societal well-being (Hahn et al., 2018, 2015). The business case for sustainability is a common approach that aligns environmental and social value forms with financial value. Making 'the business case for sustainability' concerns findings ways to increase economic performance while also reducing negative and increasing positive impacts on environmental and social sustainability issues. Used as means through which to associate the traditional business perspective with sustainability, the logic of the business case "can be seen as a rationale which guides management thinking and the justification of management decisions and activities" (Schaltegger and Burritt 2018, p.241).

Generally, business case arguments for sustainability include: cost savings through improved resource or material efficiency and cleaner production strategies; better positioning to mitigate and prevent political, market and reputational risks; increase in brand value and improvement of reputation; better recruitment, retention, and morale of employees; stronger economic valuation through transparent ESG reporting; and increased ability to innovate and adapt to unforeseen changes because of engagement with complex and multi-dimensional sustainability thinking (Schaltegger et al., 2012a; Whelan and Fink, 2016). While some approaches to the business case contend only with maintaining market viability (e.g., Parnell 2008), the business case for sustainability requires the creation of economic value *through* environmental and social activities, and not just along with them (Schaltegger et al., 2012a). The perspective of business cases for sustainability therefore characterizes positive relationships between the economic dimension and social and environmental dimensions.

2.3 Business models for sustainability

This section presents an overview of the current state of BMfS research. After tracing the concept's development from the traditional BM concept, it reviews basic BMfS properties and approaches to their development and implementation.

2.3.1 Traditional BM research

While the research is split and overlaps among streams, a BM can be generally understood as the way a company creates, delivers, and captures value (Chesbrough, 2010; Osterwalder and Pigneur, 2010; Zott et al., 2011). Although the literature lacks construct, terminology, and definitional clarity (Foss and Saebi, 2018), a general architecture of the components that make up a BM is present across studies (Saebi et al., 2017). To provide a common ontological basis, the BM and its activities are framed around three components – value proposition, value creation and delivery, and value capture – and the interactions between them (Richardson, 2008). *Value proposition* represents the value embedded in an organization's product or service and reflects the needs of the customer. The organization's activities and processes, including their resources, suppliers, partners, and distribution, represent *value creation and delivery*. *Value capture* is the organization's cost structure and revenue streams.

While helpful to separate the components to identify their related activities and main actors, the relationships between the activities, actors, and wider network must not be forgotten. A BM should also therefore be seen as an *activity system*: "a system of interdependent activities that transcends the focal firm and spans its boundaries" (Zott and Amit, 2010, p.216). The activity system perspective focuses on the interactions between BM components and the actors connected to them through aspects of content (the BM activities), structure (how the activities are linked), and governance (who performs the activities). From this perspective, BMs are the way organizations create, deliver, and capture value, with special consideration placed on the interactions between partners, customers, and institutions that allow them to conduct business, and to potentially innovate (Chesbrough, 2007; Zott and Amit, 2010).

Arising from practice, business model research has followed three general streams in its development (Foss and Saebi, 2017):

- to classify and distinguish organizations based on the ways they create and capture value (e.g., Amit and Zott, 2001);
- as a way to explain firm performance since some BMs outperform others and may be used as examples for imitation (e.g., Chesbrough, 2010; Teece, 2010); and
- as a potential unit for innovation (e.g., Zott et al., 2011).

If different BMs lead to different organizational performance, investigating their innovation and change potential is attractive for both practice and theory. As sustainability requirements and expectations are increasingly expected of organizations, and essential to the normative achievement of SD, the concept of BMs has been extended to the sustainability management domain.

2.3.2 BMfS research

The concept of BMfS and related research stemmed out of the need to link sustainability innovation, strategies, and objectives to the BMs of organizations (Schaltegger et al., 2016a). The terms 'business models for sustainability' and 'sustainable business models' are used somewhat interchangeably in the literature, but 'BMfS' is used here to highlight the decided shift toward strategic sustainability objectives required for their holistic implementation.[1] BMfS create new logics for organizations in the way they create value for their customers and stakeholders and capture that value back into the organization in non-monetary forms. The concept is argued to translate organizational level sustainability innovation to larger system level transformation (Boons and Lüdeke-Freund, 2013; Proka et al., 2018; Schaltegger et al., 2016a) by serving as a mediator between sustainability innovations and their success and uptake in the wider socio-technical context (Lüdeke-Freund et al., 2019; Lüdeke-Freund, 2020).

[1] It should be noted that the original version of the CapSEM model (presented in Fig. 3) uses the term 'sustainable business model' (SBM), though future revisions of the model shall use the term 'BMfS' to better represent the strategic orientation of the concept and research field.

Paralleling the fragmentation and ambiguity of the BM literature, recent reviews expose the multiple definitions and perspectives associated with BMfS (Geissdoerfer et al., 2018; Lüdeke-Freund and Dembek, 2017; Pieroni et al., 2019; Preghenella and Battistella, 2021; Sinkovics et al., 2021). Main aspects of the relatively young concept and research area, however, can be summarized as the incorporation of environmental, social, and economic value, the proactive engagement of stakeholders, and a long-term perspective to doing business (Geissdoerfer et al., 2018; Preghenella and Battistella, 2021; Schaltegger et al., 2016a). Maximum profit generation is decidedly not the main objective of business models for sustainability (Bocken et al., 2014; Boons and Lüdeke-Freund, 2013; Dentchev et al., 2016), as they must seek to create, capture, and integrate stakeholder needs and environmental and social value into a new or existing BM (Stubbs and Cocklin, 2008). Figure 4 presents the BMfS ontology.

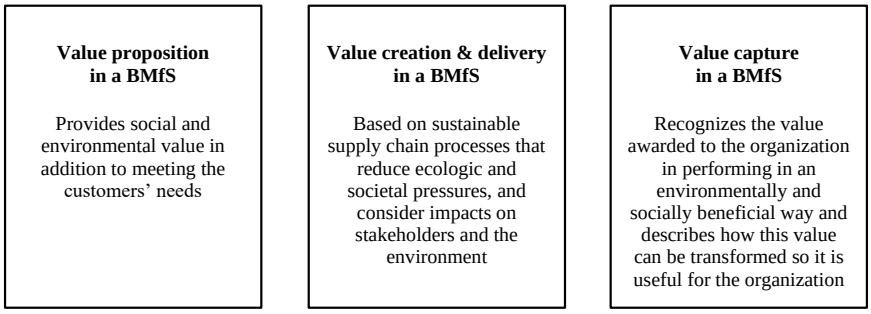


Figure 4: BMfS ontology
(based on Bocken et al. (2014); Geissdoerfer et al. (2018))

Schaltegger et al. (2016b) assert a useful definition of BMfS across the ontological components:

> *A business model for sustainability helps describing, analyzing, managing, and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value while maintaining or regenerating natural, social, and economic capital beyond its organizational boundaries* (p.4).

Organizational attributes of an ideal-type BMfS include treating sustainability as a strategy in itself, taking the stakeholder view of the firm, embedding sustainability principles into the organization and its leadership, recognizing nature as a key stakeholder, and tracking and

reporting on sustainability progress (Stubbs and Cocklin, 2008). Increasing the performance of its environmental management and sustainability portfolio is argued to lead to the competitive advantage of an organization (Kramer and Porter, 2011; Schaltegger et al., 2012b), and BMfS create multiple forms of value that are theorized to help an organization remain both financially viable and contribute to sustainable development (Dentchev et al., 2018; Evans et al., 2017; Lüdeke-Freund and Dembek, 2017; Schaltegger et al., 2016a, 2012a).

Organizations have a critical role to play in societal transitions (Geels, 2011) and BMfS require the connection of organization activities to societal needs (Stubbs and Cocklin, 2008). There is need for more research that explicitly links business models and transitions research for sustainability (Bidmon and Knab, 2018; Boons et al., 2013; Boons and Lüdeke-Freund, 2013; Wells, 2013). A growing number of articles begin to assess this relationship, and focus on mapping the correlations between corporate sustainability, business model innovation (BMI) and sustainability transitions literature (e.g., Bidmon and Knab, 2018; Koistinen et al., 2018).

Because this thesis analyzes the sustainability management approaches within the organization, socio-technical transitions theory (e.g., Geels, 2011; Geels and Schot, 2007) is outside of its scope. However, recognizing the link between organizations and society must be engrained in the sustainability management process. There is no theoretical framework that connects business models, and the roles of BMI, directly to markets, industries, or society (Schaltegger et al., 2016b), and existing transition theories are missing a theory of the firm (Sarasini and Linder, 2018). There is therefore a need analyze the dynamics of an organization and its sustainability innovation outside of the traditional sense of the firm (Proka et al., 2018).

Other approaches therefore focus more on business models as a transformative means to represent sustainable business development strategies. Proka et al. (2018) discuss how BMs can contribute to sustainability transitions and assert that corporate sustainability approaches to BMfS, remain focused on firm performance in the traditional sense, and do not fully internalize environmental and social externalities. They therefore introduce a framework of three main features associated with transformative BMfS, i.e., those with the potential to "radically change the system". The features are: 1) *Broad value orientation*, which expands from the traditional sense of money as the only value and incorporates non-monetized aspects such as internal and external externalities, 2) *Broad stakeholder network* that expands from customers as the focus to include all societal actors, 3) *Reflexivity*, because society is dynamic

and changing, and BMs must therefore be able to change and adapt (Proka et al., 2018). Each of these features further emphasizes the interactive relationships between companies, their stakeholders, and markets. To study the mediating role of BMs between sustainability innovations and business cases for sustainability, Lüdeke-Freund et al. (2018) and Lüdeke-Freund (2020) develop a framework that situates the interplay of sustainability strategy, business model innovation for sustainability, and business case drivers within the wider societal context. This approach exposes both the motivations and barriers from stakeholders and the market, such as limitations for technological innovation of the BM due to current infrastructures or institutional influences from sustainability-forward investments and policies (Lüdeke-Freund, 2020).

2.3.3 Changing BMs for sustainability

Business model innovation (BMI), in the traditional sense, is focused on the successful commercialization of new technologies or ideas through a company's business model (Chesbrough, 2007), and can occur through the addition of novel business model activities, by linking activities in novel ways (a change in BM structure), or by changing the parties that perform the activities (a change in BM governance) (Amit and Zott, 2012). Because a sustainability-oriented strategy dictates the redefinition of the values that are created by and drive the organization, it also requires redefining how business is done (Schaltegger et al., 2012a), and innovating the BM to incorporate and reflect strategic aims and developments.

Innovation is "the effort to create purposeful, focused change in an enterprise's economic or social potential" (Drucker, 2002, p.6). Distinction can therefore be made between the BM as the system or architecture of interacting value components, and a BMI as "designed, novel, and nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017, p.216).

BMI for sustainability (BMIfS) is therefore the means through which organizations adapt or change existing business models or create entirely new ones grounded in the reduction of negative and increase of positive impacts for sustainability. Put more simply, BMIfS is "the conceptualization and implementation of sustainable business models" (Geissdoerfer et al., 2018, p.405). It also requires the simultaneous consideration of the BM within its activity system, the three dimensions of sustainable value, active engagement with stakeholders, and a

long-term perspective, all while organizations manage day-to-day operations and viability (Stubbs and Cocklin, 2008). The multidimensional aspects of SD can be difficult to balance and decision-making between continuing activities that support the financial viability of an organization yet do not support its sustainability objectives, is difficult. This necessarily impacts the established organizational norms of the company (organization level), the network of actors that surround the company (inter-organizational level), and the external normative sustainability pressures placed upon it (system level) (Boons and Lüdeke-Freund, 2013).

Different categorizations of BMI for sustainability, and the resulting types of BMfS, have been asserted across the literature. Some are classified into archetypes based on the main type of innovation that directs the BM towards sustainability: technical, social, or organizational (Bocken et al., 2014; Boons and Lüdeke-Freund, 2013), while others delineate them based on the type of problem their value creation solves (ecological, social, and/or economic) (Lüdeke-Freund et al., 2018). Other research strands focus on different types of BMfS such as BMs for the circular economy (e.g., Lüdeke-Freund et al., 2019; Nußholz, 2020; Pieroni et al., 2021), BMfS for micro-, small-, and medium-sized enterprises (e.g., Pucihar et al., 2019), and base-of-the-pyramid BMs (e.g., Dembek et al., 2018). Still, a gap in the research exists between what BMIfS is, and how organizations practically undertake it (e.g., Inigo et al., 2017).

2.3.4 Approaches and tools for BMfS

The BM can be a helpful tool in practice for conceptualization of an organization's strategy. Practitioner tools for BMfS ideation and development come in different forms. Taking an inside-out approach, some tools begin with mapping an organization's current BM elements along sustainability dimensions to identify areas for reducing negative or increasing positive sustainability impact (Joyce and Paquin, 2016). Other approaches take the outside-in perspective and look to types of BMfS that have worked for other organizations and have been categorized into archetypes (Bocken et al., 2014; Joyce and Paquin, 2016).

Applying an outlined framework may help the organization capture the full picture of activities and actors. As a result, its strategy or plans for change can be idealized across multiple situations and actors and discussed along a common model. Practitioner tools for BM mapping, ideation, and innovation been developed and include, for example, the business model canvas (BMC) (Osterwalder and Pigneur, 2010). The BMC further divides the three business model

components into nine "building blocks," comprised of the value proposition; key partners, key activities, key resources (value creation); customer segments, customer relationships, and channels (value delivery); and cost structure, and revenue streams (value capture).

Extending the original BMC (Osterwalder and Pigneur, 2010), numerous canvases have been developed to integrate sustainability dimensions for BMfS (e.g., Foxon et al., 2015; Joyce and Paquin, 2016; Tiemann and Fichter, 2016; Upward and Jones, 2016). Some studies have shown that mapping tools may have a limited effect on implementing designed innovation strategies (Boons and Lüdeke-Freund, 2013; Demil and Lecocq, 2010; Geissdoerfer et al., 2018; Morris et al., 2005). However, mapping different BM elements and functions across a generalizable framework can be a helpful starting point for visualization, ideation, and communication purposes within an organization. The 'triple layered business model canvas' (TLBMC) (Joyce and Paquin, 2016) extends the original economic focused BM canvas to include additional layers for environmental and social value creation. The TLBMC should be performed in two steps – first as a baseline outlining the current BM and interactions, and then to identify areas for sustainable innovation opportunity. BMfS mapping and conceptualization can therefore help outline status quo value creation activities and identify potential for adaption or innovation to capture more or, different types of, value.

Another approach is through BMfS archetypes, or common models of existing BMfS (Bocken et al., 2014). Archetypes identified by Bocken and colleagues are categorized according to the type of mechanism or innovation that helps the organization deliver on sustainability – technical/ environmental innovation, social innovation or organizational innovation (Bocken et al., 2014; Boons and Lüdeke-Freund, 2013).[2] Archetypes can also be grouped based on their foundational principles, e.g., the circular economy (Lacy et al., 2014; Lewandowski, 2016; Lüdeke-Freund et al., 2019) or by their main impact area, e.g., reducing negative environmental or social impact, serving underserved communities (base of the pyramid) or financing innovation (e.g., crowdfunding) (SustainAbility, 2014). The categorization of common archetypes can provide inspiration to organizations working to improve sustainability of their BM. Archetypes point out specific innovations that can transform the current BM or create an

[2] Paper 3 provides further analysis and discussion of BMfS archetypes.

entirely new BM and can be helpful in reconceptualizing current processes and identifying potential opportunities.

Further, the 'value uncaptured perspective' helps organizations identify areas of value surplus, value absence, value missed, and value destroyed so that they may be turned into value opportunities (Yang et al., 2017b, 2017a). The 'value mapping tool' plots uncaptured value types across stakeholder groups to highlight their impacts or missed opportunity areas (Bocken, 2021; Bocken et al., 2015).

2.4 Systems perspectives to sustainability

Clarity regarding improving the sustainability performance of organizations and their BMfS, like the concept of SD itself, requires multilevel assessment and conceptualization. This chapter therefore outlines aspects of systems perspectives to sustainability that underpin the analysis and finding of this thesis.

Sustainability and SD are made up of multiple interacting systems that cross societal levels, TBL dimensions, and spatial and temporal scales. Addressing the challenges of SD therefore requires an understanding of the dynamic interactions within and between them (Whiteman et al., 2013). From a systems perspective, sustainability is "the ability of systems to persist, adapt, transform or transition in the face of constantly changing conditions" (Williams et al., 2017, p.271), and is not an end goal or state, but a 'moving target' (Gaziulusoy et al., 2013).

There are many different types of systems. Most basically, a system is a set of elements in interaction. Systems can be defined as "a set of concepts and/or elements used to satisfy a need or requirement" (Miles, 1973). Boundaries determine the size of the system and can be *closed* and fixed, or *open* to influence from the environment. SD, society, and organizations are all therefore open systems. Further, they are complex systems, i.e., systems of systems, in which interactions impact their behavior and future interactions. Systems can also be classified based on the type of elements they are made up of, e.g., natural systems, social systems, or technical systems.

Systems thinking is often applied to break down the complexity of SD. It entails looking at the whole, i.e., the 'big picture', while remaining aware of the interconnections between the parts of the whole (Richmond, 1994), or taking a holistic view of the world as a complex system

(Sterman, 1994). It is critical to tie together actors and activities and to assess their relationships within and between societal levels and across sustainability dimensions. The SDGs are themselves a complex system of interacting goals that attempt to qualify and quantify human and ecological needs (Lusseau and Mancini, 2019).

Management scholars have identified the essentiality of a systems view to organizations and the dependence of business on the natural environment (e.g., Gladwin et al., 1995; Jennings and Zandbergen, 1995; Starik and Rands, 1995), but still argue for a more integrated and multilevel management approach to understanding these systems, their impacts on organizations, and organizations' impact on them (Starik and Kanashiro, 2020). A recent review of organizational literature related to sustainability and systems thinking summarizes the current state of the field and asserts the need "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" (Williams et al., 2017, p.871). Contributing to this need, this thesis has already presented several systems including SD, the societal system (Figure 1), organizations, and BMs. The CapSEM model (Figure 3) is also based on a systems approach to categorize organizational levels.

While sustainability research has investigated specific ways to add sustainability to each of the BMfS components, researchers continue to assert the need to consider sustainability across all components simultaneously (Abdelkafi and Täuscher, 2016; Boons and Lüdeke-Freund, 2013; Brehmer et al., 2018; Proka et al., 2018; Silvestre et al., 2022). In order to do so, a holistic and systemic view is needed that situates the BM within its business context, customer and stakeholder networks, value chain, and natural environment (Abdelkafi and Täuscher, 2016; Silvestre et al., 2022; Stubbs and Cocklin, 2008). Approaches that view BMs as boundary-spanning systems are therefore important to help organizations assess their BM, but also to identify areas of positive and negative sustainability impact and value creation. One such way is to view the BM as an activity system (Chesbrough, 2007; Zott and Amit, 2010), with the objective of supporting sustainability objectives through its content, structure, and governance activities. Another conceptualization is to situate BMfS within their value network, or the "set of roles and interactions in which organizations engage in both tangible and intangible value exchanges to achieve economic or social good" (Evans et al., 2017, p.601 based on Allee, 2008).

The value network, illustrated in Figure 5, highlights the different forms of sustainability value that create, flow through, and interact within a BMfS and its network of actors (Breuer and Lüdeke-Freund, 2014; Evans et al., 2017; Lüdeke-Freund, 2020; Yang et al., 2017b). Extending the perspective beyond organizational activities and resources, a systems view is helpful to incorporate the normative and complex aspects of BMfS within and beyond organizational boundaries. The inherent complexity of sustainability requires that the full system, internal and external to the organization, is considered within the BM toward sustainability objectives. This allows the identification of interactions and tensions between different types of value creation, and the resulting prioritization and decision-making behind the way forward. The concept of value creation from a systems perspective within the BM network is therefore essential to understanding the often-conflicting objectives grounded in BMfS.

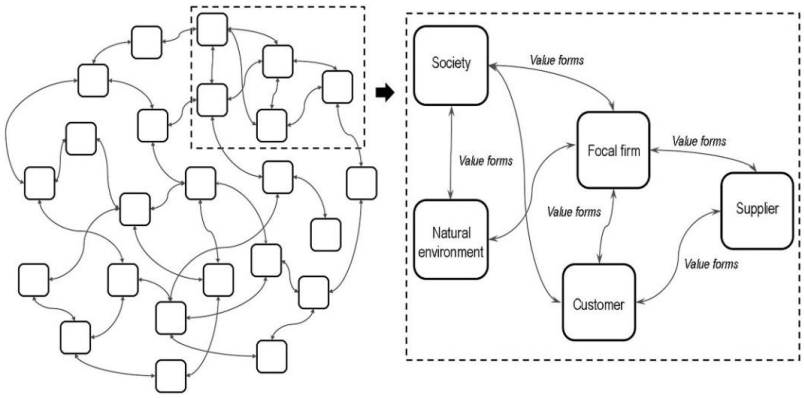


Figure 5: Sustainable value network
(Evans et al., 2017)

2.5 Organization and management theories

Since this thesis analyzes the relationships between organizations and society from the perspective of the organization, organizational theory is another important leg of its foundation. *Strategic management* theories are used to underpin organizational strategy and to explain the differentiation between firms based on their performance and legitimacy. At the organizational level of strategic management, an organization must manage its strategy in relation to its internal resources, the external environment in which it operates, and its ability to add value through its activities (Lynch, 2018). While sustainability management and BMfS do not yet

have their own organizational or management theory, aspects of existing theory have been applied to analyze and study the dynamics of organizations' development and implementation of sustainability strategies (e.g., Lozano, Carpenter, and Huisingh 2015; Starik and Kanashiro 2013, 2020). An integrated theory, created by drawing on multiple theoretical approaches, may therefore be best for explaining and analyzing the complexities and dynamics of sustainability management (Edwards, 2009; Starik and Kanashiro, 2020).

Starik and Kanashiro (2020) present a comprehensive overview of research linking existing management theories and sustainability management approaches. Table 3 presents an overview of the sustainability-related values of existing management theories, and the societal levels which they address. They are multilevel theories themselves and are therefore valuable lenses through which to view sustainability management and BMIfS. In addition to the overview presented in Table 3, the next sections present further discussion of the sustainability related aspects, and limitations, of the resource-based view, stakeholder theory, institutional theory, and paradox theory. These theories have been selected for their prevalence in sustainability-related research, and for their relevance to the scope of this thesis.

2.5.1 The resource-based view and natural-resource-based view

Resource-based view (RBV)

Levels: Meso and macro

Aim: Maximizing firm performance through unique combinations of resources

Unit of analysis: Resource base of the firm

Focus: The RBV takes an internal look at an organization to identify its resources and capabilities, and their unique combinations, that differentiate it from its competitors (Barney, 1991). *Resources* are something the firm possesses, and can be physical, financial, or tacit, such as employee skills or organizational or social processes (Hart and Dowell, 2011). Based on the combination of resources and practices, *capabilities* are the routines the firm is then able to perform or deploy in order to manage the resources and create value (Barney, 1996). The RBV "addresses the fit between what a firm has the ability to do and what it has the opportunity to do" (Russo & Fouts, 1997, p.536) based on both its internal (e.g., organization history, and corporate culture) and external (e.g., demand, and public policy) resource constraints and opportunities (Conner, 1991).

Table 3: Contributions from existing management theories to a multilevel sustainability management theory (redrawn from Starik & Kanashiro (2020))

Socio-ecological levels	Management theory contributions	Sustainability-related values
Micro, meso	Stakeholder theory: Highly-ethical relationships may result in sustainability. Relationships are characterized by joint-wealth creation, high levels of mutual trust and cooperation (Freeman et al., 2010)	Morality, ethical relationships, equality, peacefulness, diversity, shared responsibility
Micro	Upper-echelon theory: Leaders who lead in unpredictable and urgent circumstances are able to reconcile multiple conflicting goals (Schaubroeck et al., 2012)	Genuine, ethical leadership
Micro	Agency theory: Maximizing firm's value in the long-term necessarily implies a triple-bottom line goal (Jensen and Meckling, 1976; Lan and Heracleous, 2010)	Triple-bottom line
Micro	Attention-based view: The closer the issue (and its negative consequences), the more difficult it is for participants to ignore it and the greater likelihood that participants will perceive the emergency and urgency of the issue (Galbreath, 2018; Ocasio, 1997)	Emergency and urgency
Micro, meso	Institutional theory: Individual beliefs, cultural norms, and societal institutions have the potential to influence sustainable development (Delmas and Toffel, 2008; DiMaggio and Powell, 1983; Rivera et al., 2009)	Paradigm shifts, behavioral changes
Meso, macro	Resilience theory: Organizations, societies, and humans have an ability to adapt to adverse situations. However, external disturbances have different intensity levels and their impacts vary according to contextual factors and availability of resources (Williams et al., 2017)	Adaptation, resilience
Meso, macro	Resource-based view: Recognition that the natural environment represents a source of competitive advantage, since the natural environment is valuable, rare, and very difficult to imitate but possible to integrate into the organization's strategy (Hart, 1995; Kim et al., 2017; Russo and Fouts, 1997)	Scarcity, rareness
Micro, meso, macro	Tension paradox theory: Cyclical responses to paradoxical tensions enable sustainability (Hahn et al., 2015; Smith and Lewis, 2011)	Equilibrium, adaptation, resilience
Meso, macro	Economic models: Consider generation and distribution of wealth across generations. Models account for limited amount and efficient use of resources (Arrow, 1970)	Inter-generations, efficiency

Sustainability philosophy: Sustainable value (in the TBL sense) can be increased by enabling an organization's unique combination of resources and capabilities that support its sustainability objectives (Starik and Kanashiro, 2013). Value is created when resources are valuable, rare, inimitable, and supported by the firm's capabilities in a combination that increases customers' willingness to pay or lowers the costs of the firm, thus supporting their competitive advantage and viability (Barney, 1991). The value of resources depends on their interaction with market forces, and other contextual factors such as industry dynamics at a given point of time (Collis and Montgomery, 1995). For example, using fewer material resources lowers costs for the organization, allowing it to have reduced impact on the environment through resource efficiency. According to the RBV, the organization differentiates itself by translating its lowered resource costs into increased profit (products sold at original price), and/or by capturing the customers' willingness to pay a higher price for products produced more eco-efficiently than competitors. The BM here can be seen as the mediator between resource efficient activities and the strategy of the organization, since the way in which the organization classifies and captures the created value back depends on its overarching strategy and business model. However, the RBV does not provide any theoretical basis for understanding how changes in the BM directly affect firm performance. Further, limitations of the RBV for sustainability management arise because of its lacking consideration of the external environment and finite number of resources (Hart, 1995; Hart and Dowell, 2011), and of its promotion of competition over collaboration for unique resource capabilities rather than shared resource capabilities (Starik and Kanashiro, 2013).

Natural-resource-based view (NRBV)

Levels: Meso and macro

Aim: Maximizing firm performance through unique combinations of resources while recognizing constraints of the biophysical environment

Unit of analysis: Resource base of the firm

Focus: The NRBV inserts the natural environment, and the resource constraints and opportunities it enacts on a firm, into the RBV (Hart, 1995; Hart and Dowell, 2011).

Sustainability philosophy: Because the natural environment provides valuable, rare, and inimitable resources, it itself is a source of competitive advantage (Starik and Kanashiro, 2020).

The NRBV provides a theoretical connection between environmental action and profit, thus supporting the business case for sustainability and the 'environmental-financial performance link' (Hart and Dowell, 2011). The NRBV proposes four strategic capabilities that link competitive advantage possibilities with contributions to environmental and social sustainability. These are pollution prevention, product stewardship, clean technology, and base of the pyramid strategies that support both competitive advantage for the organization and positive influence on society and/or the environment (Hart and Dowell, 2011). Increasing environmental performance through these strategies has been shown to have a positive influence on economic performance (Russo and Fouts, 1997). For example, in terms of its physical assets and technology, the firm must adapt its value creation and delivery processes in line with its environmental strategy, therefore reducing negative environmental impact, building know-how in the company, and profiting from improved efficiency and reputation.

The premises of the RBV and the NRBV help to explain aspects of competitive advantage and may therefore help to expose specific capabilities that support sustainability objectives. The focus on issues internal to firms, however, does not sufficiently capture the multi-directional interactions between issues *external* to the firm, and firm performance. Although the NRBV recognizes that the natural environmental is the foundational resource base supporting and constraining the activities of firms, it still looks at value creation through the profit maximization lens and does not incorporate the needs or consideration of stakeholders (Freudenreich et al., 2020; Stubbs and Cocklin, 2008). The normative values of SD cannot be captured within the RBV/NRBV since all actions are equated to firm reputation and self-interest. From a BMfS perspective, this means that mutual value creation for the organization and its stakeholders, a key tenet of the concept, is not addressed.

2.5.2 Stakeholder theory

Levels: Micro, meso

Aim: Value creation for the firm and its stakeholders

Unit of analysis: The firm and its relation to stakeholders

Focus: Stakeholder theory asserts that the role and objective of business is to create value for all stakeholders, not just shareholders (Freeman, 2010, 1984). It proposes an alternative to the production view of the firm and highlights the impacts of relationships between an organization

and its many stakeholders, suggesting that "values are necessarily and explicitly a part of doing business" (Freeman, Wicks, and Parmar 2004, p.364). Stakeholders are understood here as "any group or individual who can affect or is affected by the achievement of the firm's [or organization's] objectives" (Freeman 2010, p.25). This extends the recognition of stakeholders beyond actors traditionally considered in neoliberal firm theories, such as the RBV, and suggests a moral obligation of firms to manage for all groups. In addition to customers, suppliers, employees, and shareholders, stakeholder theory also emphasizes the influence of actors such as government and regulators, social interest groups, and the media on organizations (Freeman, 1984). Table 4 provides an overview of organizational stakeholders in relation to sustainability, across social and non-social, i.e., environmental, aspects.

By operating ethically and acceptably for stakeholders, the organization can signal and maintain its legitimacy (Freeman, 2010). According to Carroll (2015), "in a real sense, the stakeholder concept has given firms and managers language and concepts for carrying out their missions with respect to people and groups with which they interact and hold responsibilities" (p.92). Stakeholder theory therefore takes a more action-oriented approach to management than other theories that prescriptively describe the firm (Freeman, 2010). The approach rests on the ability of managers and organizations to systematically engage with their stakeholders, strengthen their relationships with them, and form responses that balance organizational and stakeholder needs in line with organization strategy and ethical responsibility. These stakeholder engagement activities surround identifying relevant stakeholder groups, determining their needs and interests and the potential impacts of these on the organization, and then implementing this into organizational decision making and value creation processes (Freeman, 2010). Ultimately, this results in value creation that is mutually beneficial to the firm and its stakeholders (Freudenreich et al., 2020).

Sustainability philosophy: Stakeholder theory is one of the most frequently applied theoretical approaches in corporate sustainability and sustainability management research (Chang et al., 2017; Hörisch et al., 2014; Montiel and Delgado-Ceballos, 2014). Its direct assertion of the need to understand the relationships between an organization and actors in its societal context reflects core SD principles. Further, aspects of the environmental and social 'external environment' are embedded in its philosophies (Freeman, 2010, 1984). Though essential, building stakeholder relationships is a complex and time-consuming task, and organizations often face constraints due to lack of knowledge or hesitation to redistribute resources toward

engagement activities. Each activity and process affect a new group of stakeholders, and therefore require an organization to constantly engage, monitor, and integrate their needs (Freeman, 2010). There has also been a shift from managing stakeholder needs, as prescribed in the early years of the approach, to interacting with them to create value *jointly* in line with SD (Freudenreich et al., 2020). Shared value creation (Kramer and Porter, 2011) provides one conception of the interlinked and mutually beneficial relationship between society and an organization. Recognizing that an organization's ability to create value is dependent on its engagement and balance of stakeholder interests and needs (Freeman, 2010), stakeholder engagement activities are an essential part of any organizational sustainability approach.

Table 4: Examples of an organization's stakeholders across primary and secondary and social and non-social groupings (adapted from (Lozano, Carpenter, and Huisingh (2015))

	Primary stakeholders	**Secondary stakeholders**
Social	• Shareholders and investors • Employees and managers • Customers • Unions • Suppliers and other business partners • Local communities	• Government and regulators • Civic institutions • Social pressure groups • The media and academia • Trade bodies • Competitors • The general public
Non-social	• The natural environment • Future generations • Non-human species	• Environmental pressure groups • Animal-welfare organizations

While initially more focused on social stakeholders, research connecting stakeholder theory and sustainability management is extensive, with stakeholder engagement being a core principle of BMfS (e.g., Geissdoerfer, Vladimirova, and Evans 2018). In fact, the mutual value creation required by BMfS is generated through stakeholder engagement. Stakeholder engagement is therefore an essential activity of sustainability management. Organizations cannot solve sustainability challenges alone, and the integration of stakeholder needs into organization activities is necessary for sustainability orientation. It requires that the organization build capabilities to establish high-quality stakeholder relationships in which organization and stakeholder values for sustainability are aligned, and that it recognizes the influence of stakeholders on the BM through e.g., their contribution to industry standards, and the influence of the BM on stakeholders resulting in e.g., cooperative networks, adapted consumption patterns, sustainability knowledge building (Fobbe and Hilletofth, 2021). BMs

should therefore be seen as more than devices of value creation, and instead be recognized as "devices that organize and facilitate stakeholder relationships and corresponding value exchanges" (Freudenreich, Lüdeke-Freund, and Schaltegger 2020, p.3).

However, there is still a gap in understanding the connections between stakeholder management within organizations and its effect on macro level sustainability, and vice versa (e.g., Garvare and Johansson 2010; Starik and Kanashiro 2013, 2020). Stakeholder theory is embedded with normative aspects of SD such as mutual value creation and a long-term horizon (Hörisch et al., 2014), yet it is still often treated as an 'add-on' in organizational strategy (Fobbe and Hilletofth, 2021), and as a theory, does not address the macro level.

2.5.3 Institutional theory

Levels: Micro, meso

Aim: To explain firm behavior based on context

Unit of analysis: Firm behavior related to institutional contexts

Focus: Institutional theory extends resource-based explanations of firm differentiation and competitive advantage to describe the effects of institutions on firms (Meyer and Rowan 1977). Organizations operate within and are influenced by their *institutional context*, constituted by "the rules, norms and ideologies of the wider society" (Meyer and Rowan 1983, p.84) and "common understandings of what is appropriate and, fundamentally, meaningful behavior" (Zucker 1983, p.5). An *institution* can be defined as "more-or-less taken-for-granted repetitive social behavior that is underpinned by normative systems and cognitive understandings that give meaning to social exchange and thus enable self-reproducing social order" (Greenwood, Oliver, Suddaby, & Sahlin-Andersson, 2012, p.4-5).

According to institutional theory, there are two forces that influence organizational behavior: 1) complex networks that form institutional contexts and are made up of relationships between actors that shape institutions, and 2) the desire of organizations to conform to their institutional context and its institutions to gain *legitimacy* and license to operate (Meyer and Rowan, 1977; Scott, 1983). There is a dynamic relationship between these two forces that influences organizational behavior. Interactions within actor networks create norms of what is appropriate and/or expected, complexity within networks leads to different responses to these norms, and

these responses then lead to differences in organizations and changes in the norms (DiMaggio and Powell, 1983; Greenwood et al., 2012; Meyer and Rowan, 1977; Scott, 1983).

The dynamics and aspects of institutional theory can be examined across three pillars (Scott, 2005, 2001, 1995). The *regulative pillar* concerns actions led by influential organizations that guide institutional change toward what society considers to be 'right' through formal rule systems and their enforcement. The *normative pillar* is characterized by social obligation and morally governed ideas of what is appropriate and acceptable within a given institutional context. The *cultural-cognitive pillar* represents the taken for granted and shared understandings that result from the cultural frames, e.g., religious, of the institutional context. To signal legitimacy and license to operate, firms conform to their institutional context and its accepted ideas of what is appropriate and right, i.e., they become *isomorphic*, through coercive, normative, and mimetic mechanisms of diffusion (DiMaggio and Powell, 1983). Organizations may also realize opportunities for increased access to resources by responding strategically to institutional norms (Oliver, 1991).

The ***institutional logics perspective*** within institutional theory provides a way to analyze the interrelationships between patterns of beliefs and values, known as *logics*, on multiple levels of social systems (Durand and Thornton, 2018; Friedland and Alford, 1991), and recognizes that institutions both constrain organizations and provide them motivation and agency for change (Thornton and Ocasio, 2012). Institutional logics exist on multiple levels, from macro-level logics (e.g., families, religions, states, markets, professions, and corporations (Thornton, 2004)), to organizational level logics (the combination of specific society level logic(s) that organizations use to form their values and guide their decisions), and individual level logics (the societal and organizational level logics that guide and develop an individual's beliefs). Actors within each level develop their own values based on a combination of logics. The institutional logics upon which organizations base their values and decision making are referred to as 'organizational value logics' (Laasch, 2018). They represent the value institutionalized within the organization, and therefore depend on the specific context in which the organization operates. Though outside the direct scope of the thesis, aspects of the individual level, such as agency and leadership, are also fundamental in understanding logics and organizational decision-making.

Institutional leadership is related to the management of institutional values and identity of an organization and the decisions that must be made to uphold, adapt, or change those values when institutional contexts and logics change (Askeland, 2020; Selznick, 1957). Institutional leaders, i.e., managers in the scope of organizations, respond to the dominant or changing logics to develop leadership systems and practices across technical, political, and cultural dimensions (Selznick, 1957). The *technical dimension* of institutional leadership concerns the business model activities managed to continue the survival of the organization (Besharov and Khurana, 2015; Radoynovska et al., 2020). These are the tangible activities and resource combinations that lead to its continued operation. The *political dimension* concerns the management of the organization's relationships and is further divided into the internal and the external politics of the organization, which situate the organization strategically in its environment. Such is achieved through directed and intentional leadership activities that manage relationships within the organization, and between the organization and individual and societal levels (Besharov and Khurana, 2015; Radoynovska et al., 2020). The *cultural dimension* relates to values of the organization and the leadership activities that investigate and uphold them. It brings together the technical and political dimensions (Radoynovska et al., 2020), so that technical activities are aligned with organizational values and those values align with the expectations of political actors and the institutional context. This is the value-laden dimension (Besharov and Khurana, 2015; Selznick, 1957) in which organizational values are more than symbols of the organization's beliefs but become tied directly to the integrity and identity of the organization (Radoynovska et al., 2020; Selznick, 1957).

Summarized by Thornton and Ocasio (2012), "perhaps the core assumption of the institutional logics approach is that the interests, identities, values, and assumptions of individuals and organizations are embedded within prevailing institutional logics" (p. 103). This means that while individuals and organizations do have rational choice and agency, such is a result of and entrenched within the societal context in which they operate (Greenwood and Suddaby 2006). Because an organization's logic guides organization strategy and culture, it also therefore strongly influences organizational behavior and the design of its business model.

Sustainability philosophy: Institutional theory recognizes the "inter-institutional societal system" in which norms and values are developed and upheld (Friedland and Alford, 1991) and situates organizations within their multilevel institutional context. This conceptualization is that presented in Figure 1 and used as a frame throughout the thesis because of its

representation of one of the multilevel systems of sustainability, i.e., relationships between different levels of society. As norms and expectations change at the societal level, organizational and individual level actors decide whether to conform and resultingly influence their position in the societal system and collaborative networks. As asserted by Bansal (2005), institutional theory is relevant to corporate sustainability because:

> *(1) individual value and belief systems judge a firm's commitment to sustainable development, affecting perceptions of the firm's acceptability and legitimacy (Bansal and Roth, 2000); (2) actors with differences of opinion on issues of corporate sustainable development will dialogue and debate to establish norms and common beliefs (Hoffman, 1999; Wade-Benzoni et al., 2002); and (3) elements of sustainable development are becoming institutionalized through regulations and international agreements (Frank et al., 2000)* (p.202).

Institutional theory considers the impacts and complexity of interactions within networks of actors influenced by varying, and sometimes conflicting, pressures and beliefs – a key perspective for understanding the intricacy of sustainability management and tensions between TBL dimensions.

Institutional complexity exists in contexts of multiple, and potentially incompatible, logics and challenges organizations as to which norms and rules to follow (Greenwood et al., 2011). Clearly defined organizational strategies and objectives are then important to manage conflicts between logics and organizational and individual values, while still maintaining organizational identity (Askeland, 2020; Selznick, 1957). Table 5 provides an overview of two competing logics faced by organizations in the transition to sustainability – the *commercial market logic*, rooted in neo-classical economics, efficiency, financial value creation and shareholder primacy, and the *sustainability logic*, based in regeneration, stakeholder inclusion, and non-financial value creation. Aspects of each of the logics are presented in relation to each of the BM components.[3] These societal level logics affect the logics and business models at the organizational level (Thornton and Ocasio, 2012). For example, the value proposition serves the purpose of meeting the needs of the customer, and as dominant institutional logics change and conflict, these needs are likely to change, as well as expand into new domains. The basis

[3] The discussion of organizational logics also continues in Paper 4.

of value, as monetary/ non-monetary, also poses a challenge as the BM must be adapted to exchange and capture social and environmental value for itself and its stakeholders (Laasch, 2018).

Table 5: Competing value logics (created after Laasch (2018))[4]

BM component	Commercial value logic	Sustainability value logic
Proposition (P): What kind of value does the organization offer to whom?	What kind of products or services are to be proposed to the customer on which market	The social, environmental, and economic value proposition to multiple stakeholders as a contribution of an organization to sustainable development
Creation (Cr): How does the organization create value?	What the company needs to create these products and services	What is needed to create this value in a sustainable way
Exchange (E): How does the organization exchange value?	How these are exchanged with the customers and the wider value creation network including suppliers and distributors	The systemic exchange of value through relationships with multiple stakeholders
Capture (Ca): How is the value created by an organization captured?	How the company ensures economic viability, grows, and captures a profit for its owners and investors	How the value is captured and distributed as social, environmental, and economic impacts over time, defining the optimum scale of an organization

The institutional logics perspective provides a helpful way to frame and conceptualize the tensions between competing logics and values, and therefore contributes to the description and explanation of resulting challenges in sustainability management and BMfS. As a result, it also shows the need for clear organizational objectives and strategies from institutional leaders that comprehend the multilevel and multidimensional aspects of sustainability objectives in changing institutional contexts. Both the theory and perspective therefore provide a conceptualization of the organizational context and values essential for developing and implementing BMfS that support macro level SD. It is within the cultural dimension of institutional leadership that strong sustainability values can be integrated, to guide decisions and relationships in the political dimension and structures of activities in the technical

[4] Note that here the BM is divided into four components to place focus on the importance of value exchange in relation to the consideration of a wide network of stakeholders.

dimension. At this point, the prescription of specific actions and strategies for managers and organizations to take in practice is lacking, as this also necessitates changes at the macro level, i.e., a shift in the management paradigm, for empirical observation (Laasch et al., 2020). Key researchers at the intersections of BMfS and the institutional logics perspective have however begun investigating responsible management and responsible leadership to fill this gap (e.g., Gherardi and Laasch 2021; Laasch and Pinkse 2020; Radoynovska, Ocasio, and Laasch 2020).

2.5.4 Paradox theory

Levels: Micro, meso, macro

Aim: To explore how organizations and managers can attend to various tensions simultaneously by conceptualizing the different types of tensions and approaches to understand them, and finding a 'dynamic equilibrium' between acknowledgement, management, and resolution strategies (Hahn et al., 2015; Smith and Lewis, 2011).

Unit of analysis: Organizations and managers

Focus: Paradox theory in management recognizes that there are many tensions faced by organizations, and that there is potential in recognizing, understanding, and analyzing them (Poole and Van de Ven, 1989). It assumes that "tensions are integral to complex systems and that sustainability [in the financial sense] depends on attending to contradictory yet interwoven demands simultaneously" (Smith and Lewis 2011, p.397) A common tension in organizational theory, for example, is that between exploitation (maximizing short-term efficiency) and exploration (searching for new opportunities for long-term resilience) (Smith and Tushman, 2005). Organizations can respond to tensions through different management strategies – by recognizing and accepting inherent opposition between poles, by separating the poles of the tension spatially (in location or distance) or temporally, or by reframing the tension to find resolution between the poles (Poole and Van de Ven, 1989). Further, the response of leaders to tensions may relate directly to an organization's long-term performance (Quinn, 1988).

Sustainability philosophy: Applying paradox theory to corporate sustainability is relatively recent (Gao and Bansal, 2013; Hahn et al., 2018, 2015), though the tensions in managing TBL sustainability in organizations have long been recognized (e.g., Margolis and Walsh 2003; Van der Byl and Slawinski 2015; Vilanova, Lozano, and Arenas 2009). The paradox perspective on

corporate sustainability "accommodates interrelated yet conflicting economic, environmental, and social concerns with the objective of achieving superior business contributions to sustainable development" (Hahn et al., 2018, p.237).

Identified tensions in the corporate sustainability domain exist in the simultaneous work towards aspects of each of the TBL dimensions; between private values (organization level) and long-term shared values (society level); in the simultaneous engagement with potentially conflicting stakeholder demands; between presumed legitimacy in the current market and structural or technological change; and between the efficiency of the organization and the resilience of socioeconomic systems (Hahn et al., 2015; Wannags and Gold, 2020). So, while academics and managers may be able to identify them, developing cohesive strategies to address them individually and simultaneously is an extremely complex task.

Though tensions typically come with a negative connotation, the paradox approach asserts that organizations and managers must accept these tensions and find ways to work through them so that competing sustainability objectives can be reached simultaneously, even if they may conflict with profitability (Hahn et al., 2018). While empirical research on tensions in corporate sustainability is lacking (Van der Byl and Slawinski, 2015), it provides an important perspective in which environmental and social aspects are assigned the normative and fundamental value they deserve. It is then up to organizations and managers to (re)design and (re)direct their strategies towards an integrative view that accepts and embraces tensions, rather than defending against them (Smith and Lewis, 2011).

To address the interactions and tensions across corporate sustainability, the focus on business case perspectives must shift to one that recognizes the inherent tension, or paradox, between financial aims and true environmental and social sustainability on the system level. The paradox perspective provides an 'integrative view' to corporate sustainability that acknowledges that organizations must work toward different sustainability aspects at the same time, and that they are likely to contradict in the process. Further, the integrative logic of tensions recognizes that the TBL dimensions are "inextricably connected and internally interdependent" (Hahn et al. 2018, p.236). This is in direct opposition to the 'instrumental logic' of the traditional view of firm performance and the business case for sustainability in which the aspects of one dimension, i.e., the financial, are determined to be more instrumental to the organization and prioritized over the others (Hahn et al., 2015; Wannags and Gold, 2020).

While still in its emerging phases, a paradox theory to sustainability management specifically recognizes the multidimensional and multilevel interactions between sustainability dimensions, and between the actions of managers (individual level), organizational strategy and culture (organizational level), and the needs and objectives of society-level sustainability.

Table 6 summarizes the main limitations of the selected management theories in terms of their ability to capture the multilevel complexities of sustainability management. Along with the research gaps highlighted in Chapter 1, these reconfirm the need for a multilevel theory that captures the intricacies, complexities, and multiple systems of SD.

Table 6: Limitations of selected management theories

Management theory	Limitations
RBV: The BM can be seen as the mediator between resource efficient activities and the strategy of the organization	• Lacking consideration of the external environment and finite number of resources • Promotes competition over collaboration for unique resource capabilities rather than shared resource capabilities – contradicts shared value creation concept
NRBV: Recognizes that the natural environment is the foundational resource base supporting and constraining the activities of firms.	• Looks at value creation through the profit maximization lens and does not incorporate the needs or consideration of stakeholders. • Normative values of SD cannot be captured since all actions are equated to firm reputation and self-interest. • From a BMfS perspective, mutual value creation for the organization and its stakeholders, a key tenet of the concept, is not addressed.
Stakeholder theory: Recognizes the influence of stakeholders on the BM through e.g., their contribution to industry standards, and the influence of the BM on stakeholders resulting in e.g., cooperative networks, adapted consumption patterns, sustainability knowledge building.	• Gap in understanding the connections between stakeholder management within organizations and its effect on macro level sustainability, and vice versa. • Embedded with normative aspects of SD such as mutual value creation and a long-term horizon, yet it is still often treated as an 'add-on' in organizational strategy. • As a theory, does not address the macro level.
Institutional theory: BM represents system for exchanging sustainable value in wider institutional contexts and highlights tensions in changing logics	• The prescription of specific actions and strategies for managers and organizations to take in practice is lacking. • Institutional pressures differ widely across sectors, locations, cultures and may be difficult to conceptualize in practice without more specific guidance for leadership
Paradox theory: Specifically recognizes the multidimensional and multilevel interactions between sustainability dimensions, and between the actions of managers (individual level), organizational strategy and culture (organizational level), and the needs and objectives of society-level sustainability.	• Up to organizations and managers to (re)design and (re)direct their strategies towards an integrative view that accepts and embraces tensions, rather than defending against them – but how? • Currently, specific actions and guidance lacking to operationalize the integrative view.

2.6 Addressing the research questions

Based on the concepts and theoretical foundations outlined in this chapter, the following propositions have guided the research process:

RQ 1: Sustainability management and BMfS require multilevel conceptualizations of an organization's impact and relationships across levels of society, the organization, and the individual, and across the dimensions of sustainability. The CapSEM model is a framework that organizes methods and tools across many of these dimensions

RQ 2: Within an organizational system, sustainability management can be addressed using the perspective of BMfS as a mediating layer between operational activities and organization strategy. The BMfS can therefore be seen as a facilitating mechanism between organizational activities, and their advancements toward increasing sustainability, and an organization's long-term sustainability strategy

RQ 3: No existing organizational theory addresses all sustainability aspects and dimensions on its own, but a multilevel conceptualization of BMfS can support organizations in their sustainability management. What, how and why of such theory is presented in Chapter 5

3 Research approach

This thesis is of a theoretical nature and is a result of the combination of diverse qualitative and exploratory research activities across the BMfS concept and the CapSEM model. Stemming from *and* based within the conceptual and theoretical approaches presented in the previous chapter, two general research streams emerged, BMfS on the one hand, and the CapSEM model on the other. The four appended papers, and the experiences gathered throughout their conduction, have exposed the breadth of levels and dimensions required to pragmatically address sustainability management. In this way, the research process has guided its own further direction and informed the complex selection of practical and theoretical perspectives necessary for the all-encompassing multilevel and multidirectional approach to be strived for by organizations in their sustainability journey. The result is a contribution to multilevel theory through the linking of conceptual frameworks in Chapter 5.

3.1 Research philosophy and worldviews

Scientific research is conducted from multiple ontological and epistemological positions that combine into philosophical paradigms, broadly: positivist/post-positivist, constructivist, critical/transformational, and pragmatist (Creswell, 2014; Robson, 2011). Each paradigm is a "…basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways" (Guba and Lincoln, 1994, p.105). The main philosophical paradigms battle across the *positivist/post-positivist* (related mainly to quantitative methods) and the *constructivist* (related mainly to qualitative methods) divide. Ontologically, this divide concerns the belief in an objective versus subjective reality, and epistemologically, that knowledge is based on experience, and should be value free, versus that knowledge is context dependent and based on the values and interpretations of the researcher (Robson, 2011). The *critical paradigm* asserts that science can never be objective or value-free and addresses issues such as inequality, social change, and power imbalances. *Pragmatism* exists somewhere between the positivist–constructivist dichotomy and recognizes, instead, that whether a fully objective or subjective reality exists is "inconsequential", and that "truth is always just in front of us" (McCaslin, 2008, p.673).

While many qualitative studies take a social constructivist worldview, the ecological basis of sustainability, mandates the consideration of a more positivist epistemological view of the natural world and its physical constraints (Vildåsen et al., 2017). Further, the study of organization and management theories can never be neutral because they "encapsulate the interests and the agendas of dominant parties and aim at affecting change in line with such rationality" (Kelemen and Rumens, 2012, p.7). Researchers have suggested an explicitly pluralist approach to understand the multiple dimensions (environmental, social, economic), societal levels (micro-macro), interrelations, and values that make up long-term corporate sustainability strategies (Vildåsen et al., 2017). A Pragmatist worldview has therefore grounded this thesis, which focuses on recognizing the research problem and applying plural theoretical lenses to studying its practice and process (Simpson, 2018). A Pragmatist recognizes that "truth is always present, it is always now, and concerns itself with how we use it now to understand our realities…" (McCaslin, 2008, p.673). Methodologically, three core principles guide this approach: "1) an emphasis on actionable knowledge, 2) recognition of the interconnectedness between experience, knowing, and acting, and 3) inquiry as an experiential process" (Kelly and Cordeiro, 2020, p.3). These principles guided the research process described in the next sections, and the use of explorative observations and existing research to analyze BMfS the CapSEM model through inductive and deductive lenses.

3.2 Research process

This study seeks to contribute to a multilevel theory of sustainability management through the linkage of conceptual frameworks that describe and explain the perspectives needed to support an approach to integrated and holistic sustainability in organizations. According to Meredith (1993), theory is built through reiterations between description, explanation, and testing of conceptual models until they fully capture the phenomena under study. A typical theory building research process is presented in Figure 6. Lüdeke-Freund (2020) situates current sustainability-oriented business model research within the description and explanation phases of this process and asserts the need for conceptual models that "consistently integrate the available knowledge and allow for systematic empirical testing" (p.667). Although conceptual research is sometimes criticized for lacking empirical objectivity, the novelty of the BMfS field dictates further description and explanation through conceptual approaches (Lüdeke-Freund, 2020).

Based on the status of research in the field, this study followed an evolving process of knowledge integration to construct conceptual description and explanation that contributes to the development of multilevel sustainability management theory. Experience gathered in the research activities, along with research gaps identified pre-study and throughout the process, then led the selection of future research activities.

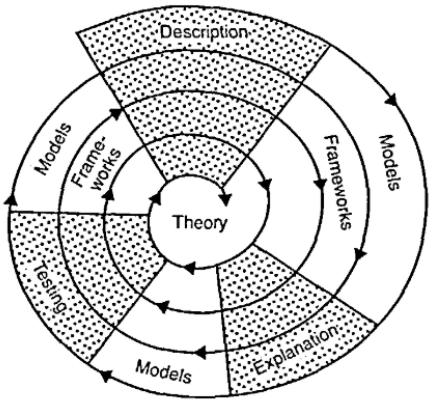


Figure 6: The normal research cycle (Meredith, 1993)

The study surrounds two parallel research streams and their related activities:

- Research stream 1 – Business models for sustainability, and
- Research stream 2 – The CapSEM project and CapSEM model,

which framed the research questions, conceptual framework, and research design. Based on these research streams, research activities evolved to investigate overlaps and relationships between them that could expose and explain the knowledge needed for organizations to build their sustainability management capacity.

This approach unfolded overtime, and eventually, the initial investigation into the CapSEM model and BMfS streams led to the future identification and analysis of key relationships between the streams and new areas for analysis. Within this process, important concepts and applicable theories were compared and applied in different combinations to expose their relationships and contributions to sustainability management and BMfS. By reiterating objectives and conclusions, and relationships between concepts, new phenomena can be

described at a level that captures its complexity (Meredith, 1993). Combined with the research activities undertaken in each of the appended papers, the conceptual and theoretical foundations and analysis (Chapter 2), have grounded the resulting observations and analysis so that research results contribute to new knowledge based on experience. Ultimately, these experiences and resulting new knowledge then inform the theoretical contribution of this thesis. The background, methods and findings related to the research streams and the individual papers are therefore presented in detail in the next chapter along with an overview figure of the research process.

4 Research papers and results

The research activities in this PhD project have contributed to exposing the need for multilevel approaches to sustainability management and BMfS. The results are detailed in the following sections and make three main contributions:

- Insight for organizations to close the design-implementation gap in changing or innovating their BMs for sustainability through the development and use of the CapSEM model (RQ 1)
- Support for the perspective that BMfS can be a mediating layer within an organization (between its operational activities and sustainability strategy), and between an organization and the multilevel context in which it operates (RQ 2)
- Multilevel considerations of organizations and their BMs for a more integrated sustainability management theory (RQ 3)

The development and application of the CapSEM model helps organizations situate themselves within the complex context of SD and exposes and explicates the different systems in which organizations are part. BMfS is used as both a representative concept, characterized by the value proposition, value creation and delivery, and value capture ontology, and as a conceptual framework that shows its mediating ability within the organization (between operational activities and organizational strategy), and beyond the organization (with value network actors and wider society).

The study is grounded in qualitative methods that allow phenomena and events to be observed in their natural setting (Creswell, 2014). Due to the evolving nature of the study, one overarching research design was not applied. Instead, different methods were applied across the appended papers to inform and direct the process. Understanding the progression of the research process, and the relationships between the two research streams, is therefore necessary to appreciate its findings. Figure 7 presents the progress and development of the research process across the two streams. The size of the boxes does not represent the time or importance of the research activity, but rather the relation of each of the activities to the two main research streams (described in sections 4.1 and 4.2). The next sections then detail the background, methods and findings of the research process and each paper activity.

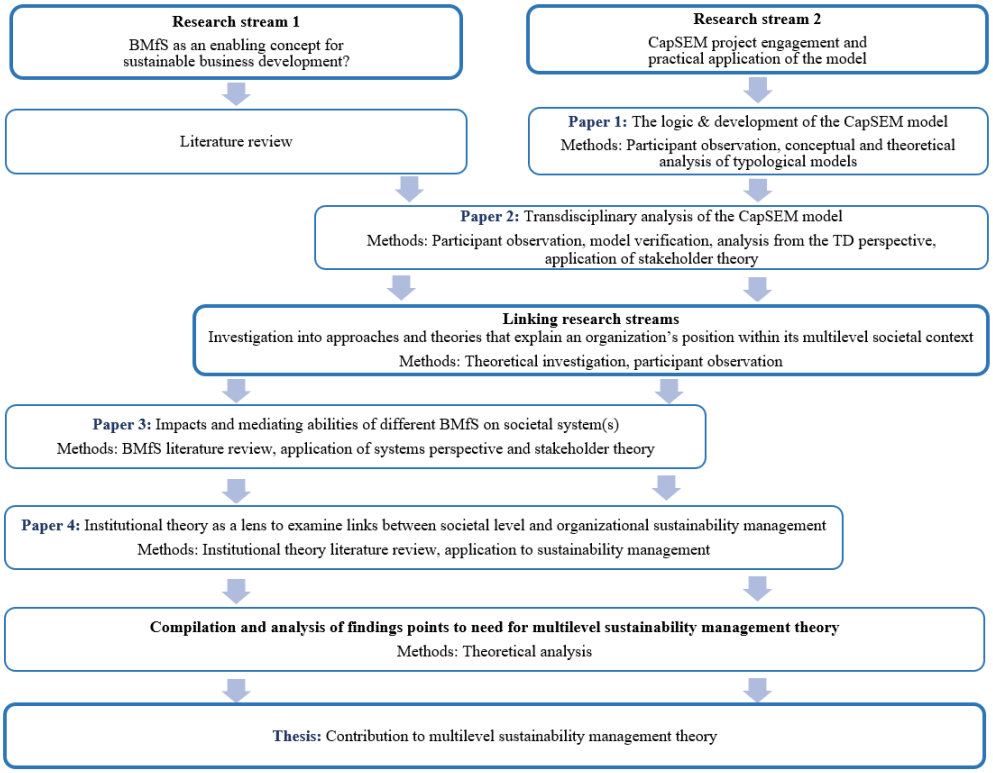


Figure 7: The research process

4.1 The start: the BMfS research stream

This PhD project was founded on ideas of studying how the concept of BMfS could support and enable sustainable business development. Initial activities therefore intentionally took an *exploratory approach*, which seeks to develop theory from the collection and observation of data (Cooper and Schindler, 2011) and therefore follows an inductive research process (Stebbins, 2001). Exploratory approaches are particularly valuable when studying a new and unclear area of research, as they help researchers better define and operationalize concepts, set priorities and proactively design the research approach (Cooper and Schindler, 2011). The novelty of sustainability management and BMfS research, along with the complex dynamics of an organization's multilevel context, reinforce the value of the exploratory approach for developing the conceptual grounding on which they stand.

In the early days of the study, a *literature review* was conducted to outline the current state of the art and to point to gaps for further research. In general, the literature review contributes to a number of study aspects, including establishing its need in the field, positioning it within existing research and setting a benchmark for new results and findings (Creswell, 2014). The literature review was initially approached broadly, applying past research experience to survey corporate sustainability, sustainability management, and BMfS literature for its theoretical foundations and documented drivers and barriers for uptake in organizations. Numerous systematic literature reviews exist to try to make sense of the novelty and resulting fragmentation of research and constructs within these fields (Bocken et al., 2014; Boons and Lüdeke-Freund, 2013; Comin et al., 2019; Geissdoerfer et al., 2018; Hahn et al., 2015; Marczewska and Kostrzewski, 2020; Montiel et al., 2020; Montiel and Delgado-Ceballos, 2014; Preghenella and Battistella, 2021; Sinkovics et al., 2021). As a result, existing reviews combined with continuous review of released publications was decided to be sufficient for guiding and grounding the exploratory and subsequent phases.

Based on the initial literature review, many of the challenges related to BMfS were the result of limited sustainability knowledge and capacity in organizations, difficulty balancing environmental, social, and economic dimensions (e.g., Schaltegger et al., 2012), and limited perspectives that ignored relationships with the surrounding levels of society and stakeholders, or between the components of the BM, sustainability-oriented innovations, and organizational strategy (e.g., Boons and Lüdeke-Freund, 2013). The objectives therefore became finding ways to help organizations better situate themselves within the societal systems in which they operate, and to support knowledge building in sustainability management through approaches that take a holistic sustainability perspective. Based on this grounding, the appended papers were developed. Thus, after a brief presentation of the CapSEM model research stream, the next sections introduce the papers along with their associated research activities and methods.

4.2 The CapSEM model research stream

Presented in Figure 3, and again in Figure 8, the CapSEM model organizes a toolbox for sustainability and environmental management across organization system levels of production processes (Level 1), product and value chain (Level 2), organization management (Level 3), and the societal system (Level 4). The basis of the CapSEM model was developed through

Professor Annik Magerholm Fet's 25 years of engagement with industry in the subjects of environmental management, CSR, and, more recently, sustainability management approaches that integrate social aspects in addition to the environmental. My work with the CapSEM model began in 2016 with its application as the foundation of the research project application and resulting project objectives and activities. It was in the development of the CapSEM project, that the framework became known specifically as *'the CapSEM model'*.

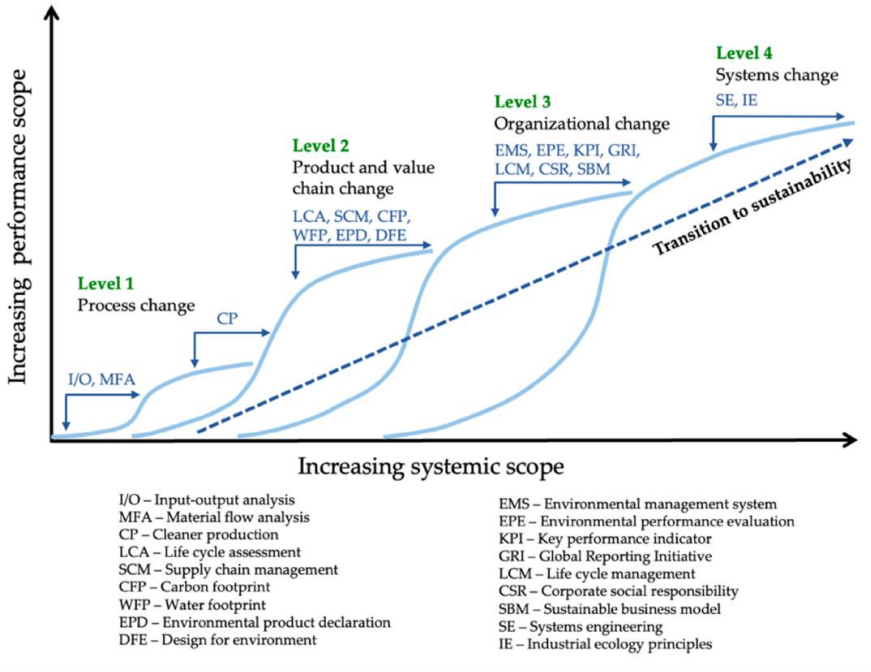


Figure 8: The CapSEM model (Fet and Knudson, 2021a)

4.2.1 Understanding the model

The CapSEM model's axes represent the scope of systems complexity (x-axis) and of performance complexity (y-axis), defined as the size of the system under study and the number of sustainability aspects under study, respectively. Each of the levels contains a selection of tools that measure the sustainability impacts and processes associated with its scope. The waves between the levels represent their additive nature, and their embeddedness within the higher levels.

Level 1 concerns the system scope of production processes and performance scope of the environmental aspects of those production processes. Tools on this level therefore relate to the quantification and management of the environmental impacts of resource and material flows within the production processes.

Moving to Level 2, the system scope expands to value chain activities. The performance scope then concerns the environmental and social aspects of the upstream and downstream processes in the value chain, such as in design, transport, and supplier selection. Tools on this level therefore move from the measurement of internal processes to the monitoring of the life cycle processes of the product(s) and value chain. For example, Level 2 provides methods for carbon- and water-footprints (CFP and WFP), life cycle assessment (LCA) and environmental product declarations (EPDs), which communicate environmental impacts of the associated products throughout the value chain to their end of life.

Level 3's scope is more difficult to conceptualize, as it moves from the physical system scope of a production process or value chain to an organization's strategic employment of management concepts and systems to design, implement, and monitor a sustainability strategy. Considering the performance scope, Level 3 requires the incorporation of more social sustainability aspects than the previous levels through tools and perspectives that help to manage the ethical responsibility and business case of sustainability. It expands to include sustainability aspects within and beyond the organization. BMfS (represented as 'sustainable business model' (SBM) in Figure 3 & Figure 8) and CSR can prescribe more holistic approaches to sustainability management than the previous resource quantification measures, and further link their interactions within a system of activities, i.e., the business model. Further, setting key performance indicators (KPIs) and using reporting systems such as the Global Reporting Initiative (GRI) help the organization best couple its sustainability efforts with its overall sustainability strategy. Level 4 concerns the macro system, or societal system, level, and therefore the most complex performance scope.

Achieving Level 4 and applying its perspectives requires a systematic and holistic consideration of the organization and its place within the societal system. Reaching such a performance scope ultimately entails the redefinition of value to include non-monetary aspects of regeneration and well-being, and collaboration over competition. Perspectives of systems engineering (SE) and industrial ecology (IE) are grouped in Level 4 as they provide approaches

to designing and managing complex systems in line with natural principles. Such support the normative prescription of SD on a grand scale.

As project coordinator and a member of the project group, the CapSEM project and the application of the CapSEM model through its activities provided an arena for *participant observation* (Robson, 2011). In addition to the project objectives, scientific aims of the observation included decerning the CapSEM model's ability to help organizations increase their sustainability knowledge, and of the related challenges and areas for improvement. Although issues of subjectivity often arise in relation to the participant observation method, it supports the Pragmatist's view that the truth is that which is in front of us and serves as one of the main research methods of this thesis.

Observations of the application of the CapSEM model showed that it was a helpful way to frame the systems across which organizations manage their sustainability impacts. Separating an organization's activities and outlooks into specific levels eased engagement with the expanse of methods and tools. Drawing boundaries between these activities meant that engagement could take place at a smaller scale at first, and with more capacity building and learning, could then expand into to the more complex levels.

4.2.2 CapSEM project activities

The structure of the project and its activities was grounded directly within the initial model framework. While writing the project funding application, the four levels of the model provided a temporal scale to activities. That is, after an introduction to the model and its systems-based philosophy, project activities began focusing on the lower process- and product-levels, before connecting them to the organizational- and societal system-levels.

Through the application of the model, the CapSEM project's objectives were:

1) To develop sustainability and environmental management curricula at universities that meet local, regional, and international needs;
2) To develop and host industry training seminars that provide companies with practical methods for improving their sustainability and bridge the gap between academia, industry, and wider society; and

3) To facilitate cooperation between the consortium, industry partners and their stakeholders.

To reach the objectives, activities included capacity building workshops and discussions between partners surrounding the model's philosophy, each level of the model, as well as the divisions between them. Further, they included the development, or heavy adaptation, and implementation of at least one master's-level course at each Ugandan, Indian, and Nepalese University, and industry and stakeholder engagement and training programs with the CapSEM model and its methods as their backbone. Table 7 provides an overview of the university partners and multi-disciplinary range of departments involved, along with the industry sectors and organizations that were engaged in project activities.

4.3 Paper 1: The logic and development of the CapSEM model

> Fet, A.M. & Knudson, H. (2021a). An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model). *Sustainability*, 13.

Status: Published 2021 in Level 1 publication. Though the journal has since lost is recognized ranking, critical peer-review took place at the time of publication and a high-level academic content editor assessed this special issue.

Though applied vigorously across CapSEM project activities, the CapSEM model's conceptual and theoretical grounding had not yet been explicitly described. Paper 1 was therefore undertaken to meet the task. It resulted in the publishing of the CapSEM model as a *typological conceptual model* (Meredith, 1993) that provides a descriptive representation of the complexity and varying approaches and systems within sustainability management to its users.

4.3.1 Methods

Based on the combination of participant observation and analysis of its theoretical and conceptual cornerstones, Paper 1 presents the CapSEM model as conceptual framework that can support organizations in their engagement in sustainability management and to increase the sustainability in their business models. It traces the CapSEM model's progressive development through the advancement of sustainability perspectives over the last 30 years and

describes the systems thinking logic that grounds the levels and placement of tools within it. Based on my experience with its implementation in the CapSEM project, Paper 1 reflects upon the process of the CapSEM model's development as a systems-based conceptual framework and provides contribution to RQs 1–2.

Table 7: CapSEM project partners and involved organizations

University partner	Location	Involved department(s)	Industry sectors and organizations
European partners			
1. Norwegian University of Science and Technology	Trondheim & Ålesund, Norway	Dept. of Industrial Economics and Technology Management; Dept. of International Business	Cement (2) Waste management & recycling Maritime
2. Delft University of Technology	Delft, the Netherlands	Dept. of Engineering Services and Systems	Renewable energy Port management
3. Instituto Superior Téchnico at the University of Lisbon	Lisbon, Portugal	Center for Innovation, Technology and Policy Research	Environmental management consultancy
Ugandan partners			
4. Makerere University	Kampala, Uganda	Dept. of Geology and Petroleum Studies; Dept. of Wildlife and Natural Resources Management	Cement Agriculture (Oil palm) Agriculture (Tea) Agriculture (Sugarcane) Wildlife education Local government environment offices National Planning Authority
5. Makerere University Business School	Kampala, Uganda	Dept. of Marketing and International Business	
6. Mbarara University of Science and Technology	Mbarara, Uganda	Dept. of Community Health	
Nepalese partners			
7. Tribhuvan University	Kathmandu, Nepal	Center for Applied Research and Development; Dept. of Architecture and Planning	Renewable energy (2) Medicinal plants Cement Telecom
8. Kathmandu University	Dhulikel, Nepal	Dept. of Environmental Science and Engineering	
Indian partners			
9. Indian Institute of Technology Bombay	Mumbai, India	Centre for Environmental Science and Engineering, Dept. of Environmental Science and Engineering	Women's foundation for wastewater management Municipal Council Environmental consultancy Environmental technology (2)
10. Tata Institute of Social Sciences	Mumbai, India	Centre for Climate Change and Sustainability Studies	Plastic recycling association

4.3.2 Main findings

Earlier models (e.g., Bras, 1996; Fet, 1997) have classified environmental performance areas representative of the systems in which negative sustainability impacts occur. These reflect the levels in the CapSEM model and follow the historical development of environmental management approaches and life cycle-based environmental management tools, beginning with cleaner production and pollution prevention strategies and advancing to more integrated and holistic approaches such as industrial ecology and sustainable development. Early models classified the environmental performance areas and their related approaches for mitigation and prevention across scopes of time, i.e., the length of time that the method or approach addressed, from the product life cycle to the company lifetime and human lifetime, and scopes of environmental concern, i.e., the phase in which the environmental impact occurred, from manufacturing, use, and disposal within a product life cycle to value chain and society level impacts. The CapSEM model uses these boundaries to guide its definition of the four levels but does so in a progressive way, so levels are seen to build on each other, just as smaller systems react with the larger ones that surround them.

The improvement of earlier models, advancing approaches to sustainability management, and its application in the CapSEM project, supported the fine-tuning of the CapSEM model as presented in Figure 8. Paper 1 acknowledges limitations of the model while also recognizing its value as a tool to ground organizations' sustainability work by providing a conceptualization of the systems and sustainability aspects they must address.

By engaging with the systems and related methods and tools within the model, organizations can familiarize themselves with and build capacity in what may have previously been an overwhelming area. Capacity then develops in identifying approaches for improvement in environmental and sustainability management based on their specific sustainability impacts and performance objectives.

When moving between levels, organizations may identify tensions or limitations in relation to requirements or assumptions in methods at the other levels. Such shows the limited scope of certain methods, in which environmental or social impacts are weighted more heavily and supports the need for multilevel approaches to sustainability management and strategy development to understand relationships between the TBL dimensions.

Paper 1 also provides an example of the way the SDGs can be situated along its levels. When faced with meeting objectives set by the SDGs, such mapping provides organizations an entry point for relating their operations to the goals and to the interconnections between SDG objectives and systems levels.

A final observation in Paper 1 highlights the main focus of the model on methods concerning the environmental pillar of sustainability. Progressing towards Levels 3 and 4 extends the focus to specifically include the societal pillar. Most environmental management accounting methods depend on quantitative methods that measure physical flows and impacts, producing quantifiable and objective results. Measuring sustainability in terms of impact on society is a much more subjective task, and methods that find ways to translate social value forms into quantifiable impact are increasingly under development, though much more limited that environmental accounting methods.

At this point in the research process, the CapSEM model's conceptualization of multiple systems levels (RQ2) and its ability to support knowledge building (RQ1) was the frame for further reflection and analysis.

4.4 Paper 2: Transdisciplinary aspects of the CapSEM project and model

> Fet, A.M. & Knudson, H. (2021b). 'Transdisciplinarity in sustainability management' in Keitsch, M.M. & Vermuelen, W.J.V. (eds.) Transdisciplinarity for sustainability: Aligning diverse practices, Routledge/ ISDRS Series in Sustainable Development Research, Routledge, pp. 93-117.

Status: Published 2021 in Level 2 book

Paper 2 is a book chapter published in *Transdisciplinarity for sustainability: Aligning diverse practices*. In line with the book's objectives, it uses the participant observation from the CapSEM project to analyze both the model and the project activities from a *transdisciplinarity* (TD) perspective. TD is a "critical and self-reflexive research approach that relates societal with scientific problems; it produces new knowledge by integrating different scientific and extra-scientific insights; its aim is to contribute to both societal and scientific progress" (Jahn et al., 2012, p.8).

4.4.1 Methods

Applying the recognized essentiality of stakeholder engagement in sustainable business development and in the application and practical use of the CapSEM model, Paper 2 helps to further analyze how the model itself embeds and supports stakeholder engagement. Focus is placed on how to the TD perspective can give organizations a way to collaborate with their stakeholders and their impacts across TBL dimensions. It addresses the following RQ:

> *Paper 2 RQ:* From a perspective of TD, how does the CapSEM model, and did the CapSEM project, capture principles for collaborative knowledge development in sustainability management?

Transdisciplinary collaboration requires collective problem definition and solution through the combination of diverse views for integrated and reflexive knowledge synthesis (McGregor, 2017), and is prescribed as a research approach specifically suited for solving wicked problems, such as sustainable development (Brandt et al., 2013). A conceptual model of the ideal TD research process divides the approach into three iterative phases for knowledge development and mutual learning: 1) *Formation of a common research object*, in which linkages between societal and scientific problems are identified and transformed into a shared problem, 2) *Production of new knowledge*, when knowledge related to the shared problem is integrated across disciplines, and 3) *Transdisciplinary integration*, when the value of the new knowledge is assessed for its contribution to societal and scientific practice (Jahn et al., 2012).

The implementation of the CapSEM project, and the CapSEM model itself, are separately analyzed from a TD perspective. Applying a TD approach is useful for reflection to highlight the complex interactions embedded in both the model itself, and in the activities and relationships between project stakeholders. While the model and project were not explicitly designed from a TD perspective, their characteristics and activities mirror many of its principles. These include the inherent complexity of sustainable development, trying to make sense of the multiple disciplines in which sustainability and environmental management methods are rooted, and the need to bring together scientific and societal (e.g., industry and stakeholder) perspectives to jointly solve problems. Extending the contributions of Paper 1, this paper adds empirical observation of the model's application in a multicultural and multidisciplinary context.

To illustrate the ways the CapSEM model, in its structure and prescription of methods, supports and mirrors cases of capacity building in diverse organizational contexts, Paper 2 presents *industrial case examples* based on CapSEM project activities. These cases do not represent case studies in the traditional sense but describe and explain the CapSEM model as a conceptual framework, and how it helps expose links between its levels. Future case studies could therefore be conducted to empirically test the success of the model for contribution to theory, in reference to the final phases of the theory development research cycle presented in Figure 6. Paper 2 provides input to thesis RQs 1 and 3.

4.4.2 Main findings

Analysis from the TD perspective led to identification of strengths and weaknesses of the model, and areas for improving stakeholder collaboration in future international capacity buildings settings such as the CapSEM project. This produced valuable findings that support strengthening the future application and use of the CapSEM model, and, ultimately, the need for a multilevel approach to sustainability management that considers the variance in needs and priorities across contexts.

Based on its alignment with the ideal TD research process (Jahn et al., 2012), the CapSEM project is regarded as an example of 'small range' transdisciplinarity in which societal stakeholders are engaged, but not integrated enough to empower them fully in joint knowledge development between academia and society. The scope of this thesis surrounds sustainability management and BMfS within organizations, so some aspects of the analysis presented in the paper (e.g., related to academic curriculum development and university and funding body bureaucracy) are not discussed further here. Instead, the stakeholder engagement and system view of sustainability embedded in the methods and structure of the model are elaborated for their contribution to the objective and RQs of the thesis.

Knowledge rooted in many disciplines is essential to reach improvements that lead to more sustainable practices (Brandt et al., 2013; Popa et al., 2015; Schaltegger et al., 2013). In addition to the span of academic disciplines and organizational sectors that have engaged in CapSEM project activities, as presented in Table 7, the methods in the model contribute to a holistic sustainability perspective that considers economic, environmental, and social aspects. Table 8 provides an overview of the multiple disciplines embedded within each of the CapSEM

levels. The CapSEM model therefore provides organizations insight into the many disciplines needed to holistically address sustainability in their business models.

Table 8 demonstrates the explicit incorporation of societal disciplines in the higher levels of the model. While observed as a limitation of the model in Paper 1, stakeholder engagement is also important for the thorough application of methods and implementation of improvements in the scope of the lower levels. Engagement with stakeholders is embedded in the successful implementation of methods across all levels. Stakeholder engagement is not as explicit a method as the more quantitative technical approaches of Levels 1 and 2. This may result in less awareness from organizations of their societal impacts when taking only lower approaches. Paper 2 elaborates on this observation through the employment of examples from project partners of stakeholder engagement across levels of the model. One such example comes from India and shows the mutually beneficial relationships that can occur across TBL dimensions when involving the values and needs of stakeholders across organizational system levels.

Table 8: Overview of the methods and main disciplines at each level of the CapSEM model (Fet and Knudson, 2021b)

Level	Scope	Recommended methods	Main disciplines
Level 4	Systemic improvements	Industrial ecology principles, networks, industrial symbiosis, systems engineering, circular economy principles	Engineering, social sciences, political science, economics
Level 3	Organizational improvements	Environmental management systems, sustainability communication and reporting (GRI and SDGs), environmental performance evaluation, key performance indicators, business models for sustainability, corporate social responsibility	Technology management, economics, management, social sciences
Level 2	Product- and value chain improvements	Life cycle assessment, supply chain management, carbon- and water- foot printing, environmental product declarations, design for environment	Engineering, natural sciences, industrial ecology, technology management, economics
Level 1	Process improvements	Block diagrams, pollution prevention, cleaner production, material flow analysis, energy analysis	Engineering, industrial ecology, natural sciences, economics

The ability of the CapSEM model to help build capacity and orient organizations toward sustainability management approaches is supported by the observation of its ability to focus and conceptualize complex issues, such as SD and sustainability management in a common framework. Common problem definition is the first stage of the ideal TD research process, as it helps focus various stakeholders on a common object. In terms of CapSEM project activities, numerous project meetings were overwhelmed by discussions of the normative ideals embedded in SD, and what true sustainability means from the macro contexts of the physical global system to the needs of local communities in different livelihood contexts. As academicians from diverse scientific disciplines, operating in diverse institutional, national, and societal contexts, the dilemma of the operational and philosophical objectives of sustainability could not be agreed upon within our limited time. These discussions greatly influenced collaboration between partners and the ability to appreciate contexts outside our own understandings of the world, but unfortunately distracted from the achievement of project objectives. The CapSEM model's strength as a common framework brought focus to project activities across their three years. Paper 2 therefore establishes its ability to focus diverse groups in an extension of contexts, as, in most cases, limitations in time and resources pose a significant challenge. Table 9 presents a summary of the challenges relevant to the further development of this thesis that were identified during CapSEM project implementation and TD analysis, along with ways in which the CapSEM model, as a framework, helps to address them.

Table 9: Challenges addressed through the CapSEM model

Challenge identified in CapSEM project	Addressed through CapSEM model by
Difficult to hold multistakeholder and/or multidisciplinary discussion	Formation of common terminology and system definitions
Organizations overwhelmed by available methods and lack knowledge of them	Conceptual model that provides entry point for engagement based on: • Set subsystems that can be applied to varying organizational contexts to identify areas for sustainability improvement • Categorization of expansive range of methods and tools for systematic learning
Identifying and engaging with relevant stakeholders	Breaking challenges into smaller levels allows identification and engagement with relevant stakeholders and increased ability to recognize connections and relationships across activities

4.5 Combining research streams: Applying the CapSEM model to BMfS

The ongoing review of literature, experience in the CapSEM project and Papers 1 and 2, indicated that both the CapSEM model and BMfS were approaches to help frame organizations' holistic engagement in sustainability management. The objective of the next research phase therefore became consolidating the core perspectives of the CapSEM model and BMfS to relate them to the process of improving organizations' sustainability performance. This would then delineate and explain the specific ways each contributes to engaging and situating organizations within their multilevel contexts. It was important for the PhD study at this point to extend its investigation into BMs beyond an architecture of components, and to look at the strategic and management aspects embedded in the BM activities and their relations to other organizational actors and social and environmental stakeholders.

At this point, another round of *participant observation* was undertaken within an academia-industry competence building network led by NTNU: **The Business Hub for Sustainability (BH4S)**. The main goal of BH4S is to "develop knowledge, skills and foster cooperation to transform businesses through business models that contribute to solving the challenges highlighted in the UN's Sustainable Development Goals (SDGs) for 2030" (BH4S, 2022). BH4S was started in 2020, just after the Covid 19 shutdown, and therefore shifted to digital means for knowledge exchange.

The CapSEM model is used to frame website content, and in webinars with industry partners to introduce them to the methods and approaches embedded within its levels so that they could engaged in a process to innovate their own BMs toward sustainability. I was involved specifically in hosting webinars and developing website content related to BMfS as a way to conceptualize organizational activities and to identify areas to improve sustainability performance within them. Observations provided first-hand insight into thought processes within the member organizations, a benefit of observations compared to interviews in which interviewees may not always be completely honest in their responses (Creswell, 2014). Stemming from BH4S, executive education courses based on the principles of the CapSEM model were also developed and held for local industry with the desire to become more engaged with sustainability.

Templates, such as the TLBMC (Joyce and Paquin, 2016), were used to guide the partner organizations' engagement with their current BM and opportunities to increase its sustainability through CapSEM model approaches. BMfS archetypes (Bocken et al., 2014) were also presented to provide inspiration for potential strategies to change BMs and increase sustainability performance. These observations showed that using BMfS as a common conceptual frame helped organizations better link their operational activities to the levels of the CapSEM model, and to identify ways to expand their approaches to sustainability from the lower system levels with limited scope, to the higher levels with more holistic scope.

However, two main challenges were continually observed during the sessions: 1) lacking knowledge of how to practically engage with stakeholders, and 2) selecting simple strategies that fit nicely into current operations, rather than thinking about BMfS development and adaptation on a grander scale. Of course, these are challenges widely documented in the literature (e.g., Bocken and Geradts 2019; Evans et al. 2017), but they reconfirmed the need for more practical knowledge building around stakeholder engagement and a systems perspective to BMfS that focused on linkages between levels of the societal context, rather than small process or product innovations.

4.5.1 Theoretical grounding

As a conceptual framework, the CapSEM model contributes to building organizational knowledge around sustainability and environmental management methods in approachable levels. BMfS are presented within the model as an approach on the organizational Level 3. However, how could the knowledge embedded in the model specifically support the development and implementation of sustainability knowledge and BMfS in organizations? The direction of the study therefore began to focus on approaches and theories that explained an organization's position within its multilevel societal context. This built the study's conceptual and theoretical framework upon approaches to sustainability management that conceptualize BMs as systems of interacting activities and/or help organizations engage with the environment and society, for example, sustainable value networks (Evans et al., 2017), the activity system perspective (Zott and Amit, 2010), and BMs as mediators (Lüdeke-Freund et al., 2019; Lüdeke-Freund, 2020; Osterwalder, 2004; Rauter et al., 2017).

Further, to identify which perspectives helped differentiate organizations in their sustainability management strategies, aspects of strategic management theory were applied as frames for further analysis. Multilevel approaches within stakeholder theory (Paper 2 and 3) and institutional theory (Paper 4) were therefore examined as potential theoretical frameworks for a multilevel sustainability management theory that recognizes the role of business models in working toward organizational sustainability strategy.

4.6 Paper 3: BMfS archetypes

> Knudson, H. & Keitsch, M.M. (2023). 'Helping business contribute to a sustainability transition: Archetypes of business models for sustainability' in Fet, A.M. (ed.) Business transitions: A pathway to sustainability (the CapSEM model), Springer.

Status: Published 2023 in Level 1 book

Paper 3 is a chapter in a Springer book, *Business transitions: A pathway to sustainability (the CapSEM model)*. Continued review of the literature, along with observations from my role in the CapSEM project and BH4S, presented ideas on the mediating ability of BMs. This became a key conceptual lens to the thesis, along with the importance of a systems view to the organization.

4.6.1 Methods

Through its analysis, Paper 3 provides inputs to thesis RQs 2 and 3, and is guided by the following:

> *Paper 3 RQs:* How do BMfS archetypes contribute to the inclusion of stakeholders in existing and future BMfS? How do different archetypes link to the societal level?

Paper 3 provides a literature review and analyzes the requirements for holistic organizational sustainability. It reviews the status of the BMfS research field and incorporates systems perspectives to business models. Specifically, it applies the perspective of sustainable value networks as a conceptual foundation for BMfS and discusses 'BMfS archetypes' as a tool for practitioners.

BMfS archetypes have been identified (e.g., Bocken et al., 2014; Lüdeke-Freund et al., 2018) to categorize existing BMfS, as outlined in Chapter 2. These archetypes provide inspiration to

organizations by demonstrating how BMfS differ from traditional BMs and highlight the innovative mechanisms that have been implemented by other organizations. In one of the most heavily cited studies, archetypes are grouped by their main innovation type – environmental (technological innovation), social (social innovation), and economical (organizational innovation) (Bocken et al., 2014; Bocken and Short, 2016; Ritala et al., 2018).

Observations from the CapSEM project and other industrial engagements in which the archetypes were applied, however, demonstrated that while valuable, they often had limitations when used as a guide in knowledge building setting. Archetypes could help brainstorm and identify specific areas for change within the business model, but practitioners often lacked the systems views of the way those changes would impact the rest of their BM, their overall strategy or their relationships within their value network. Examining the archetypes to highlight their specific links to the macro level therefore became the objective of Paper 3.

4.6.2 Main findings

Paper 3 asserts that the focus on one mechanism or innovation type within singular BMfS archetypes may encourage a limited view to sustainability in BMs, which in turn might influence the sustainability perception and performance in the organization. Further, it finds that the societal and economical archetypes have the greatest likelihood of impacting societal level SD because of their direct links between the meso and macro levels. As identified in the review of literature, a system perspective is essential to the successful implementation of BMs that contribute to sustainable value creation for the firm and its environmental and social stakeholders.

From a systems perspective, socially innovative archetypes, such as ‘delivering function rather than ownership’, ‘adopting a stewardship role’, or ‘encouraging sufficiency’, are the most advanced systems. This is because they are founded on the recognition that businesses and other organizations are embedded in a network of other actors including both their local stakeholders, but also macro level norms and patterns. These archetypes seek to disrupt established social patterns by taking advantage of new value capture areas such as offering a product as a service. In such a case, customers save money by not having to own specific products and use them on demand. This also supports a reduction in production footprint, a feeling of responsibility for the direction of the sustainability agenda for both the organization

and its customers and could even impact the dominant and resource-intensive make-sell-own production and consumption pattern. Socially innovative archetypes expand the structure of business interactions, and design new types of exchanges among organizations and societal stakeholders that influence macro level societal patterns.

Economical archetypes are based in changes within the structures of the business model. They are examples of BM structures that have been shifted toward sustainability and are therefore evident in organizations that have already decided to reorient their strategy toward sustainability objectives (e.g., not for profits, B-corporations, social enterprises). Economical archetypes focus on organizational innovation and therefore acknowledge the revised value orientations and logics required for improving the sustainability performance of the BM in relation to stakeholders and macro level objectives. These archetypes put stakeholder collaboration in the forefront for the development of knowledge, strategy, and operational objectives that support mutual value creation.

The environmental archetypes, then, reflect the most limited systems view as they focus on technical innovations usually within the value creation and delivery component. They are therefore aligned mainly with Levels 1 and 2 of the CapSEM model. This does not mean that they are not valuable, but that they should be combined with other archetypes more representative of the higher system levels, i.e., societal and economical archetypes. Such combination can then support the uptake of more strategic activities related to stakeholder engagement, as well as process and product improvements. More holistic archetypes may therefore be developed in the future, that influence and direct the organization's sustainability awareness and performance towards the wider system of which it is part.

4.7 Paper 4: Influences between organization and society levels

> Knudson, H. (Conference paper). Examining institutional influences and values in sustainability management.

Status: Paper submitted to the Nordic Research School in Innovation and Entrepreneurship (NORSI) Annual Conference in April 2022 and received valuable comments for strengthening the intellectual analysis. Its theoretical analysis is therefore in the process of being improved before submission to *Organization & Environment*. While recognizing these limitations, the

paper is still included in the thesis as contribution to its theoretical grounding in management studies.

Paper 4 serves two purposes. First to investigate the multidirectional relationships between organizations and institutional influences, and second to anchor organizations, i.e., their operational activities, business model, and sustainability strategy, within the multilevel societal system. This requires a shift in perspective from an organization's position in the societal context, to the influence of institutions on organizations.

While the link between organizations and the society level, and the essentiality of organizations for a transformation of current markets, is widely recognized, how organizations translate this into their operations and BMs is understudied (Bansal, 2005). For example, the three forms of BMfS archetypes described in the previous section help to outline the different types of innovative mechanisms that link organizational processes and BMs to the wider system level, but do not explain what motivates these changes. Because institutional theory is concerned with values, and how they are shaped and defined, and a multilevel societal context, it was identified in the literature review as a potentially valuable lens for the analysis of sustainability management processes in organizations. The study of institutional context and influences of norms and values on organizations was therefore selected for a frame for Paper 4, which contributes to thesis RQs 1– 3.

4.7.1 Methods

Qualitative observations from BH4S engagement and exploratory interviews, along with the business examples used in the paper, showed a seeming lack of connection made by organizations to their wider context. This differed widely from observations from the CapSEM project in which organizations in developing world contexts heavily linked their BMs to meeting livelihood needs (presented in Paper 2). The paper therefore applies a lens of *institutional theory,* introduced in Chapter 2, to two illustrative business cases to examine how organizational logics are impacted by different types of institutional influences. It uses the three pillars of institutions (regulative, normative, and cultural-cognitive) (Scott, 2005, 2001, 1995) as a framework for analysis, and provided answers to:

> *Paper 4 RQ:* How do institutional influences and contexts impact the organizational logics of the organizations working toward sustainability objectives?

A company engaged in BH4S activities was identified as a candidate for *exploratory interviews* about the observed shortfall in linking BMfS and the macro level in which an organization operates. Nordic Comfort Products (NCP) is a furniture producer in Norway that operates mainly in the B2B space. Recognizing growing calls for circular production in Norway, NCP began its work for sustainability in 2017, and launched a chair with a 100% recycled plastic seat in 2019. Its customers, however, have not been as willing to pay the higher price of the recycled chairs, and recouping the investment of the new product line, although supported by the government and industry associations, is proving harder than expected. Interviews were therefore conducted with NCP's Market Developer in Spring 2021. Following a semi-structured format, the interviews enabled a conversation (Kvale, 1996) that allowed the interviewee to express his experiences and perspectives. Important and relevant aspects, including the disconnect between the current BM, customer needs, and institutional influences were therefore brought to the surface.

4.7.2 Main findings

Other studies linking sustainability management and institutional theory have situated their research within one organizational field to examine links between that industry sector and sustainability (e.g., Escobar and Vredenburg 2011; Glover et al. 2014). While these studies provide empirical descriptions of specific contexts, Paper 4 analyzes two differing business examples through the three pillars of institutions (Scott, 2005, 2001, 1995). This illustrates the complex and multilevel contexts in which sustainability management must be studied through the juxtaposition of diverse examples. The paper therefore does not suggest one approach to map contexts or a specific combination of logics to guide organizations but highlights the dynamic and wide-ranging impacts of institutional norms and values on organizations when working to towards sustainability. It also further highlights the tensions in transitioning between commercial and sustainability logics no matter the context.

The two business examples demonstrate different cases of institutional influence and involvement and show how institutional logics inform and adapt to coercive, normative, and mimetic influences. Nordic Comfort Products (NCP) is a traditional market-driven organization that produces furniture. It recognized the opportunity in actively transitioning its material inputs to circular and local sources from industry and government signals. NCP still

found, however, that although supported by regulative sources, the market and its customers were not ready to pay the price dictated by products from recycled material inputs. Solar Green Energy Cambodia (SOGE), an NGO funded organization, set out as a new organization based on livelihood development through renewable energy technologies. Though based on sustainability principles at its core, its sustainability logic is now being combined with a more traditional logic as it searches for venture capital funding. Although extremely diverse, both cases show the influence of local institutional contexts on the suitability of sustainability strategies. The paper therefore serves as an investigation into institutional theory and exposed its strengths and weaknesses for understanding the multiple values embedded in the systems of sustainability management.

4.8 Development of a theoretical contribution

Based on these research activities, the final stage of research process is the development of a theoretical contribution to a multilevel sustainability management theory. Such contribution is developed within this thesis and presented in the next chapter. A *theoretical contribution* is established by improving understanding of the 'what', 'how', 'why', and 'who', 'when', 'where' of observed social phenomena (Whetten, 1989). Further, the contribution must fulfill aspects of incremental or revelatory originality and scientific or practical utility (Corley and Gioia, 2011). The study's research activities, combined with the overview of existing management theories in Chapter 2, and its findings, therefore provide inputs to understanding what, how, and why of multilevel sustainability management. This provides incremental advancement to existing approaches with both scientific and practical utility. The remaining chapters present and discuss these theoretical contributions.

5 Discussion of findings

Facing climate change and its impacts is a journey we have never undertaken before. As such, we have used the tools in our backpacks that have supported us previously. It is now, however, when leaning on these tools and the theories we use to describe them, that we see that none on its own is enough to support us fully, and that neither is tacking them together or onto existing problems. Some, in fact, make our problems bigger.

Chapter 2 sets the scene with the presentation of corporate sustainability and BMfS concepts. It then describes some of the theoretical 'tools' that been developed thus far to support organizations on their quest to transition BMs. Because BMfS link the organization to the societal level, their grounding in and analysis through organizational and strategic management theories is logical. These management theories each contribute greatly to understanding sustainability in organizations and society. For example, through the essentiality of stakeholder engagement or the mapping of impact of institutional norms and expectations. However, on their own, each has its own limitations, summarized in Table 6, in capturing the full complexity of sustainability management.

Thesis findings provide insight to the fragmented sustainability management discourse from two angles. First, to support practitioners, i.e., organizations working to improve the TBL sustainability of their business models, and second, to build theory that captures the ever-evolving and -improving sustainability management domain.

This chapter discusses the main findings, presented in Chapter 4, in relation to the overarching RQs, conceptual and theoretical foundation, and objective of the thesis. Based on the research results, the contribution of this thesis is three-fold and presented in the subsequent sections. Table 10 summarizes these contributions with links to their related research questions and appended papers.

5.1 RQ 1: Perspectives and tools to support closing the gap between ideation and implementation of BMfS

First, the multilevel aspects of sustainability management make it a complex task for organizations to engage with. Overlapping environmental, social and economic objectives,

sometimes contradicting each other's progress, make embedding holistic sustainability strategically in the business model a challenging task. *The CapSEM model supports organizations in meeting these challenges and making sense of the wide sustainability domain in relation to their BMs. The model is grounded in recognition of the multilevel context of sustainability, and the importance of stakeholder engagement for integrated sustainability management.*

The verification and use of the CapSEM model, first published in Papers 1 and 2, provides the necessary insight for organizations to contextualize their BM and identify appropriate opportunities for sustainable value creation. The CapSEM model therefore contributes to closing sustainability management knowledge gaps in two main ways. First, by supporting knowledge development in organizations around sustainability management and opportunities for business model innovation for sustainability, and second by helping them identify and situate themselves within their multilevel system and network of stakeholders to evaluate and scope future strategies and BMfS.

5.1.1 Supporting sustainability management knowledge development in organizations

The CapSEM model provides a means for organizations to build capacity and sustainability management knowledge. Thus, it helps them meet challenges often observed in the multidisciplinary and multistakeholder discussions that surround sustainability improvements. Organizations can be challenged and overwhelmed by new requirements and limited knowledge on which methods are available and useful for their specific context. By categorizing different life cycle-based environmental management and sustainability management approaches, it helps organizations identify, situate, and relate their environmental and social impacts with their operations – supporting the identification of areas for improvement in operational activities and BM structures in line with reporting requirements and stakeholder needs.

Further, the model also serves as a practical entry point for organizations to begin or advance their engagement with sustainable business development. It is a common frame around which various actors can systematically engage and discuss. Having a common model and terminology to guide planning and discussion eases what for many is the first hurdle – feeling like they do not have enough knowledge to start the discussions.

Table 10: Overview of thesis and paper contributions

RQ	Thesis findings		Research contributions
1: *Which perspectives and tools can help close the design-implementation gap between ideation and implementation of BMfS?*	The CapSEM model provides insight for organizations to build knowledge to close the design-implementation gap in BMfS	Paper 1	The CapSEM model is a conceptual framework that supports organizations in their engagement with sustainability management and work to increase the sustainability in their business models. • It provides a descriptive representation of the complexity and varying approaches and systems within sustainability management. • By engaging with the systems and related methods and tools within the CapSEM model, organizations can familiarize themselves with and build capacity in what may have previously been an overwhelming area. • Capacity then develops in identifying approaches for improvement in environmental and sustainability management based on their specific sustainability impacts and performance objectives.
		Paper 2	Through is division into *organizational systems levels*, the CapSEM model is grounded in the recognition of the multilevel context of sustainability, and the importance of stakeholder engagement and collaboration for integrated sustainability management. • The systems view required for successful implementation of sustainability principles is supported by: – Shared problem definition and knowledge production across disciplines and social and scientific practice – The model's common framework and terminology ease the process of stakeholder engagement. – Serves as a practical entry point for diverse stakeholders
	Organizational management strategies provide insight, but none fully captures the complexity on its own	Paper 4	• As sustainability competes with the market for a larger share of an organization's value logic, clear identity, objectives, and management practices will help support an organization in its journey toward greater sustainability. • Two business examples demonstrate different cases of institutional influence and involvement and show how institutional logics guide and influence different business models and their successes and failures
		Section 2.5	Review of organizational management strategies exposes their strengths and weaknesses related to their sustainability philosophies and the duty of the firm – no existing management theory covers the multilevel aspects and systems required

2: *How can the concept of BMfS help link organization and societal system levels of sustainability?*	BMfS can be a mediating layer both *within* an organization (between its operational activities and sustainability strategy), and *between* an organization and the multilevel context in which it operates	Paper 1	BMfS are placed within Level 3 of the CapSEM model to connect improvements in physical systems (operational activities at Levels 1 & 2) with system level (Level 4) principles. • The design of the CapSEM model supports an organization's conceptualization of its system levels – recognizing the relationships between objectives within each of the levels. • Seeing the full system (the model's big picture) as a set of smaller systems (each level) is needed for identifying potential tensions between the different levels
		Paper 3	• The value network perspective in business model innovation processes for sustainability is essential and exposes the need to adapt or create a BM that includes more than one archetypal innovation mechanism. • Business models that propose or exemplify changing existing societal patterns or organizational structures that do not support long-term sustainability (the societal and economical archetypes) have the greatest likelihood of impacting societal level SD because of their direct links between the meso and macro levels. • BMfS characterized by social and/or organizational innovation have the strongest link to stakeholders and, as a result, to contributing to SD on the macro level.
		Paper 4	The development and improvement of sustainability management practices and BMfS requires an organization recognize its position in its inter-institutional system. • Organizations must incorporate the patterns of beliefs and norms that support their license to operate and can help identify areas where changing practices and expectations may occur so that they can react appropriately in the strategy and business models
3: *How do the identified perspectives contribute to a multilevel theory of sustainability management***?**	Inputs for a multilevel theory of sustainability management	What	• Changing the perspective from the firm as the focal unit to the value network as the focal unit • Incorporating stakeholder management not as an add-on, but viewing the firm and its stakeholders as an integrated unit • Using a BMfS to conceptualize organizational needs and objectives across levels of the inter-institutional system, and to map the ways certain mechanisms will support or hinder their long-term sustainability goals.
		Why	• Gaps in practice and theory • Fragmented research streams • Complex and multilevel challenges for both researchers and practitioners
		How	By helping an organization recognize its context, i.e., its position within the multilevel societal system, between interacting sustainability dimensions, and within the earth system, on its sustainability strategy. • Relationships and interactions between elements of these systems, and its recognition of them, determines its ability to develop and implement a sustainability management strategy and BMfS rooted in stakeholder needs. The CapSEM model provides an approach to categorize and address these relationships and their impacts across levels of an organizational system. It can be used to help guide the framing of the organizational system, along with its strategy and activities, in relation to the interactions within it.

Additionally, the division into subsystems helps frame the organization across four approachable levels (production processes, product and value chain, organization and management, societal system) so that interconnections between activities can be appreciated and related to objectives at various levels of the societal system (Figure 1). For example, by demonstrating one way to map the SDGs along the four organizational system levels, Papers 1 and 2 provide an approach for organizations to engage with and work toward the global framework of the SDGs through the CapSEM model levels.

5.1.2 Building insight into the multilevel complexity of BMfS and sustainability strategies

The model is a representation of an organizational system across four operational levels, and therefore supplies an approach to conceptualize operational activities, i.e., the implementation of its business model. As a representation of the different levels within the organizational system, i.e., production processes (Level 1), products and value chains (Level 2), organization and management systems (Level 3) and macro sustainability principles (Level 4), understanding between the operational level of the organization and the multilevel context in which it operates is strengthened.

Improving sustainability performance relates to changes in operational processes and core activities and resources within the BMfS. This requires taking a bounded view of specific processes while simultaneously seeing the big picture. The improvement of production processes to reduce emissions, for example, can also be described as a shift in internal activities to support institutionalized objectives for sustainability of e.g., the top management, industry associations or NGOs. The link between actions on multiple levels may be difficult to recognize initially, though their interactions must be understood for to ensure long-term sustainability. Maybe a new technology increases product yield by decreasing raw material input but uses more power along the way. The carbon footprint of each of these processes then needs to be investigated. Organizations must also ensure that the design and operation of activities reflects stakeholder needs. Incorporating practices that guide the handling of relationships with other actors in the organization's business and social network, Levels 3 and 4 move beyond the management of internal production and value chain processes in Levels 1 and 2. By placing proposed innovations within the appropriate CapSEM model level, and brainstorming

connections and impacts to the objectives on other system levels, organizations may be able to prevent innovations or initiatives that turn out to be bad investments in the long-term.

The CapSEM model can also be viewed as spectrum of sustainability strategies moving from weak to strong sustainability. This view supports the development of an organizational strategy for sustainability aligned with the organization's ambition level and specific contextual environment. The categorization of subsystems in a spectrum toward most holistic sustainability, i.e., consideration of the most sustainability aspects across the widest view of an organization's network, provides a way for organizations to understand the impact level of their improvements. Because each CapSEM model level encapsulates the levels beneath it, they are representational of a progression from lower to higher sustainability performance or from limited to holistic system and performance scope. To reach more holistic sustainability, organizations must increase the scope of sustainability aspects and impacts measured from their own operations in Levels 1 and 2 to also include the higher-level aspects of stakeholder engagement embedded in their organizational strategies and management systems.

Practically, an organization can view the spectrum of levels to set and hone the ambition level of its sustainability strategy. Based on where the company wants to place itself, or where its stakeholders expect it to be, Levels 1–4 can be used to map the objectives and decide what steps to take going forward. Depending on where the organization strives to be or the level of resources or capacity available to dedicate to sustainability initiatives, its maturity and progress can be charted against the levels. It can also identify gaps based on the tools or approaches currently used versus proposed in the other levels.

Utilizing approaches prescribed in the lower levels, the values of organizational culture can be managed through leadership decisions toward sustainability objectives. Organizations with the most sustainability value embedded and upheld in their organizational strategies, i.e., those in Level 4 of the CapSEM model, best illustrate the fusion and implementation of sustainability management and culture throughout the BMfS and its values.

Identified limitations of the CapSEM model include the need to specify level boundaries more accurately, to adapt the model to different industry sectors and geographic locations, and to incorporate methods that explicitly consider social sustainability aspects as they become available. Overall, however, the CapSEM model provides advancement of the needed

conceptualization of the complexity of sustainability management. It is one way to narrow the gap between ideation and implementation of BMs that support comprehensive sustainability in all its complexities. As a common conceptual framework, it can be used to guide future research and discussion in both industry and academic contexts on the perspectives required for a multilevel approach.

5.2 RQ 2: Linking organizational and societal system levels

RQ 2 asked how the concept of business models for sustainability can link organizational and societal system levels of sustainability. *Findings indicate that BMfS help bridge organizations and societies when they are seen through two systems views. They have a mediating ability between 1) operational activities and sustainability strategies* (as shown in Figure 1)*, and 2) the organization and the multilevel context in which it operates* (as presented in Figure 2). Both views are systems perspectives that identify the elements and interactions within the organizational system and the societal system, respectively.

These findings have come through two main activities. Initially, the review of BMfS, corporate sustainability and systems literature (presented in section 2.3) informed gaps, challenges and state-of-the art in the field. CapSEM project and industry engagement activities (described in Chapter 4) then provided arenas in which to apply and test the BMfS concept as a system of mechanisms and activities that support a defined objective, e.g., increasing the sustainability performance of an organization.

The CapSEM model and its levels were used to frame the organizational systems in which a specific company operates its BM – from bottom-up (how processes and products fit into the organization's BM), and top-down (how macro-level needs and pressures drive and impact decision-making, strategy and the value captured by the organization). This section mirrors this division, first presenting bottom-up links between the organization and society and following with the top-down impacts.

Connections between organizations (universities & industry) and societal groups, and continued clarification of CapSEM model levels Shared problem definition and knowledge production across disciplines and social and scientific practice support the systems view required for successful implementation – this only happens with stakeholder engagement.

Relationships and interconnections within the BMfS network support the incorporation of stakeholder needs through wider engagement and environmental and social value creation as required by a strong sustainability strategy.

5.2.1 BMfS at the organizational level

At the level of the organization, identifying the BM concept as a mediating layer between operational activities and organizational strategy (Rauter et al., 2017) helps to situate sustainability objectives and decisions across the organization. The three layers of operational activities, business model and business strategy represent the organizational system (as shown in Figure 2). For example, using the value proposition, value creation & delivery and value capture ontology of a BM as a template, the strategic objective of reducing carbon footprint can be translated through the business model to product R&D departments to design products that meet the needs of customers (value proposition), engineers, procurers, and logistics partners (value creation and delivery), and the corporate and finance functions to balance spent and gained value (value capture). Each has their own system of operational activities to follow, and through innovations in the business model, can meet the organization's strategy.

Further, the CapSEM model embeds the mediating perspective. BMfS are positioned in Level 3 as an organizational management system between Levels 1 and 2 (production process and value chain, i.e., operational activities) and Level 4 (societal system influencing strategy). Such helps to further situate an organization within its multilevel context and take account of the wide, complex, and interconnected aspects that impact its sustainability. Though the thesis uses business models as the framing concept, the importance of a well-defined sustainability strategy to form objectives and guide decision-making should not be neglected, as it drives both the exploration of new BM activities that support its objective, and the implementation of these new activities and processes on the operational level.

5.2.2 BMfS at the mercy of multilevel systems

Second, system views of the BM itself through the activity system or value network perspective expand the view of a business model from the focal organization to a network of interconnected activities. Applying the BMfS concept strategically requires seeing it as more than an outline or architecture of what is currently happening, and to instead view it as a system of interacting

activities which may initiate change. Each interaction has consequences, and in a strategic change process, can create strategic benefits. The static framework of components is also still necessary to frame the organization's activities but should be extended to appreciate the actions and decisions that must occur to reach the organization's objectives. When some objective changes, it is then possible to map a potential path toward innovation to meet it and use the business model as a framework for the company's future structure(s) (Ritter and Lettl, 2018).

The case of NCP, for example, shows the importance of connecting business model innovation to the needs of customers and market guidelines. In theory, the use of recycled plastic as an input material in the value creation process proposes value to the customer in the form of sustainably produced chairs and responsibility embedded in the purchase. Market conditions, however, show that their customers, restricted by budget and procurement policies, cannot purchase the responsibility embedded in the furniture until their governing bodies remove financial cost as the main purchase guideline[5]. There is a disconnect between the value proposition, creation and delivery mechanisms, and NCP's ability to capture value back into the business model. Expanding their perspective of the BM to include macro-level impacts, such as procurement policies, could prevent such pitfalls. This, unfortunately is not a rare case since, as established in this thesis, expanding perspectives to the wide and complex sustainability system is a complicated task.

5.2.3 Societal level impacts on the organization

The previous sections have taken the perspective of the organization, while this section addresses links between organizational and societal levels from the macro society level view.

The institutionalization of sustainability management into an organization's BM may be influenced by, for example, regulative pressures from the state, normative pressures within the industry sector, or mimetic pressures as sustainability becomes further embedded in expectations for organization strategy. Further, pressures from individuals or groups within the

[5] Fortunately, this seems to be progressing quickly in the EU and Norway, though at the time of interviews with NCP was not reflected in their customers' purchasing decisions.

organization may dictate the need for change from within. Competing sustainability and commercial logics may become less in conflict as organizations embed new governance practices and management systems, i.e., the methods suggested by Level 3, to support multiple objectives, and likely tensions, within the organization. Environmental management systems (EMS), for example, provide an administrative framework to ingrain the control of environmental aspects and impacts (maintained in Level 1 and 2 processes) directly into the organization's reporting and management practices (Level 3). Establishing clear sustainability guidelines, incentives, and internal controls may help organizations actively root and follow-up on sustainability objectives throughout the organization.

As new sustainability logics become further institutionalized within BM systems, internal and external politics will continue to redefine appropriate operating practices toward stakeholder inclusion. The principles that define new sustainability logics are associated with the system scope of Level 4. The integration of more stakeholders, including the environment, require that the organization expand its boundaries. It is the heavy job of managers to develop and uphold organizational governance and non-market strategies that both respond to changing institutional demands and help maintain autonomy (Besharov and Khurana, 2015; Selznick, 1957). The organization cannot include the opinions and beliefs of all actors in its expanding societal network and must make decisions to continue financial viability. In the intersection of internal processes, operational activities, and organizational management systems, the importance of a clearly defined sustainability strategy that reflects the organization's values and establishes a code of conduct or guidelines for decision-making between competing logics is again highlighted. The scope of this thesis and its resulting contribution is therefore associated most with Levels 3 and 4 of the CapSEM model as these subsystems and methods take the widest account of organization responsibility and engagement with society.

5.3 RQ 3: Contributions to a multilevel theory of sustainability management

Characteristics of the management field, including its span across societal levels and its position at the intersection of research and practice, require a multilevel approach to research that is currently lacking in the field (Molina-Azorín et al., 2019). The multiple dimensions and systems within sustainability management characterize it as a complex and dynamic concept

that requires an integrated and multilevel theory (Starik and Kanashiro, 2020, 2013). RQ 3 therefore asked how the perspectives identified in this thesis through RQs 1 and 2 could help inform a theory of sustainability management that captures the dynamics of the field.

Papers 1 and 2 show that the CapSEM model is a tool that can help organizations grasp the interconnections between activities within each of its four organizational systems levels, and their impacts across environmental, social and economic sustainability dimensions. Within the higher levels of the model, methods specifically prescribe widening the perspective to include social aspects and strengthen connections with the macro level. As stronger connections with the societal context support more holistic BMfS implementation, the CapSEM model supports organizations in mapping and ideating BM opportunities. Paper 3 shows that BMfS characterized by revised social (social innovation) or economical (organizational innovation) structures have the strongest link to making macro level SD impact. The organization then contributes directly to changing societal level systems. By explicitly embedding BM structures with macro level sustainability principles such as changing production and consumption patterns, or with new sustainability-based logics that conceptualize non-monetary value, these BMfS mediate an organization's activities and the macro-level needs of its stakeholders. From another angle, Paper 4 shows the impacts of societal level institutions on the organization and the importance for the organization to view its BM as a system of activities and actors with differing values. The organization needs an overview of its multilevel context and the relationships between its activities to design BM changes that align with its strategy and values and the needs and expectations of its stakeholders and customers.

By linking the mediating perspective of BMfS and sustainability through the CapSEM model to discussions of existing organizational theories, the thesis makes contributions to a multilevel sustainability management theory. This contribution therefore comes from both exposing the need for such a multilevel theory (highlighted in Chapter 2), in addition to discussing its 'what, why and how' (Whetten, 1989). The discussion contributes to strengthening the explicit links between management and BMfS, and the value of BMfS for associating organizational- and system- levels in organization sustainability strategy.

5.3.1 The ‘what’ of a multilevel sustainability management theory

As sustainability logics continue their incorporation into business’ license to operate, organizations must make decisions that contradict the profit maximization principles of their previous strategic mandates. To conquer the fairly unexplored terrain that is strategic management in the era of sustainable development, organizations of all types will need to resituate themselves in their value chains and networks. Relationships previous built on the creation and exchange of financial value, will be redefined to absorb institutional norms and patterns that require that environmental and social value is accounted for.

A multilevel sustainability management theory claims the following foundations:

- Changing the perspective from the firm as the focal unit, as prescribed in e.g., the RBV and NRBV, to the value network of the firm, or the firm and its stakeholders as the focal and multilevel system.
- Recognizing that stakeholder management is not an add-on to existing organizational mandates and licenses to operate, but that long-term organizational sustainability across social, environmental and economic dimensions requires the firm and its stakeholders be an integrated unit.
- When seen as a system of interacting value exchanges, a BMfS is a useful way for organizations to conceptualize their needs and objectives across levels of the inter-institutional system, and to map the ways certain mechanisms will support or hinder their long-term sustainability goals.
- The CapSEM model framework further supports an organization to position itself within this multilevel system and across its organizational system levels, to practically identify and apply environmental and sustainability tools and methods to improve and report upon its sustainability performance, and to find a common vocabulary and conceptualization to discuss interwoven sustainability challenges with its stakeholders.

5.3.2 The ‘why’ of a multilevel sustainability management theory

The ‘why’ of a multilevel sustainability management theory has been argued throughout the chapters of this thesis. It is underpinned by gaps in practice and theory, and compounded by

the complexity, novelty, and expediency of the sustainable development challenge. The analysis and discussion of traditional management strategies performed in Chapter 2 exposes their relations to sustainability values and BMfS. While all are multilevel theories themselves, none fully capture the dynamics of the systems perspective of the BM, along with the interacting sustainability dimensions, and the multilevel societal system. The limitations of existing theories are summarized in Table 6 and include, for example, focus on profit maximization rather than the principle of mutual value creation inherent to BMfS and SD (RBV and NRBV), being treated as an add-on strategy rather than a strategy itself (stakeholder theory), lacking specific actions for organizations to take in practice (institutional theory), and remaining abstract and prescriptive without advising how to take action (paradox theory).

In conjunction with its appended papers, this thesis therefore asserts that while integrating existing theories is valuable, a management theory that sufficiently captures the complexity and urgency of SD on the macro level, and relates this to long-term organizational strategy and logic, cannot be the sum of their parts. The necessary paradigm shift cannot logically be rooted in the limited view of the organization as profit maximizer that is at the core of the strategic management discipline. Organizations must therefore see themselves as a system of interacting and exchanged multidimensional value, embedded in a multilevel societal system. Such integration recognizes the motion within these extremely complex systems and the need to anticipate tensions that cannot be decided and equated by financial means.

5.3.3 The 'how' of a multilevel sustainability management theory

The research activities and resulting papers demonstrate the impact of an organization's context, i.e., its position within the multilevel societal system, between interacting sustainability dimensions, and within the earth system, on its sustainability strategy. Further, the relationships and interactions between elements of these systems, and its recognition of them, determines its ability to develop and implement a sustainability management strategy and BMfS rooted in stakeholder needs. It is within the organizational system that objectives must be established to guide and hold the organization accountable.

The CapSEM model provides an approach to categorize and address these relationships and their impacts across levels of an organizational system. It can be used to help guide the framing of the organizational system in which a firm operates, along with its strategy and activities, in

relation to the interactions within it. Each level is further framed by increasing complexity, an expanded set of sustainability aspects for assessment and incorporation into the BM and its operational activities, and heavier grounding of sustainability principles within organizational strategy for improved and more mature sustainability performance.

5.4 Limitations

Though the thesis seeks to be as thorough as possible, a few limitations are present, in addition to those presented in relation to the papers. First, the study applies conceptual analysis methods that could be strengthened through more empirical analysis and testing. The CapSEM project and BH4S provided arenas for stakeholder, university, and industry engagement that exposed and informed principles and viewpoints essential to sustainability management. In an ideal process, these could be tested in case companies or projects to determine their validity in different contexts. The length of the PhD project and limitations imposed by the Covid 19 pandemic have not yet made this possible, though it is a promising avenue for future research.

Further, the scope of this thesis, along with the research field in general, remain in the descriptive and explanatory phases of the theory building research approach (Fig. 7) (Lüdeke-Freund, 2020; Meredith, 1993). The relative novelty, along with the extensive complexity, of sustainability management and BMfS require further analysis at this level, however, before moving on to empirical theoretical testing phases. Consistently expanding and changing research foci in the field require that new and existing knowledge is integrated to enable accurate description and explanation of observed phenomena including challenges and opportunities for future development. The thesis therefore contributes to this integration, strengthening the propositions of a potential multilevel sustainability management theory.

While recognizing the extreme importance of the individual level on the formation and maintenance of the normative values inherent in SD, the thesis does not specifically investigate individual level theories. Prescriptions for well-defined management strategies for sustainability depend on the individual level and are therefore present throughout the thesis, though not explicitly. Individual aspects are woven into the assessment of existing multilevel management theories in Chapter 3, and in the institutional analysis of Paper 4, though the thesis recognizes that further analysis of individual level processes for changing and upholding values is necessary for a comprehensive multilevel sustainability management theory.

Finally, the extensive scope, plethora of methods, and constant change and adaptation that must be captured in a holistic and integrated sustainability management theory, make it, while ideal, very complex to empirically test. This may mean that descriptive approaches, such as that in this thesis, need to be accepted as sufficient motivation for organizations to commit to the sustainable development of their BMs.

6 Conclusion

Improving the sustainability performance of organizations is a requirement to reach global SD objectives. While responses from government and industry vary across the globe, the market economy is explicitly linked to a global network of organizations that depend on the resources of the earth system. Pandemics, financial crises, and detrimental climate change events ripple throughout the global economy, and bring to light the interlinked environmental, social, and economic systems in which we all live. Still however, organizations typically operate within their organizational boundaries, and with the objective of financial viability above all. While this viability relates to the most basic understanding of 'sustainability' as continuing to exist, it ignores the dependence of the economy on its most basic environmental systems.

Sustainability management and corporate sustainability research investigate the concepts and processes that link the organizational and macro levels. While sustainability management research is quickly expanding, numerous gaps remain in the field. This thesis contributes to filling some of the gaps, namely: the need for clearer conceptualization of BMfS; the need for improved tools and knowledge to build sustainability capacity in organizations and to fill the design-implementation gap in BMfS; the need to better link organizational level processes with macro level society and SD; and the need to incorporate sustainability perspectives more directly into management theories, ideally resulting in a shift toward TBL sustainability values.

Based on these gaps, and documented challenges in the incorporation of sustainability values and objectives into organizational strategy and business models, this thesis make three main contributions. Its contributions are mainly theoretical, though they are informed by observation of sustainability management tools and approaches in practice. Further, its contributions help to clarify the currently fragmented sustainability management discourse from two angles – to support practitioners, i.e., organizations working to improve the TBL sustainability of their business models, and to build theory that captures the ever-evolving and -improving sustainability management domain.

The thesis' first contribution is the CapSEM model, which supports knowledge development within organizations across the multilevel system in which they operate and make sustainability-related decisions. The development and use of the CapSEM model provides organizations essential insight into their operational contexts, building the knowledge needed

to identify appropriate opportunities for sustainable value creation. Its application and enhancement through the activities of the CapSEM project demonstrated its ability as a framework to bring together diverse groups of stakeholders, many with conflicting values, to discuss and build knowledge around complex sustainability topics and methods. The model therefore contributes to sustainability management in multiple ways including:

- as a means for organizations to build capacity and sustainability management knowledge;
- to help organizations identify, situate, and relate their environmental and social impacts with their operations – supporting the identification of areas for improvement in operational activities and BM structures;
- as an approach for organizations to engage with and work toward the SDGs; and
- as a way for organizations to set the ambition and impact level of their sustainability strategy through the conceptualization of the model's levels as a spectrum of maturity with increasing complexity and performance scopes.

The second thesis contribution stems from the review and analysis of existing BMfS literature in relation to stakeholder theory in Paper 3. From another viewpoint, Paper 4 shows the impacts of societal level institutions on the organization, and the resulting importance for the organization to view its BM as a system of activities across multiple interacting systems. BMfS therefore help bridge organizations and societies when they are seen through two systems views. First, as a mediating layer between organizational strategy and operational activities to help situate sustainability objectives and decisions into the macro level societal context. For example, as NCP established their long-term sustainability strategy and integrated recycled resource streams and new production technology to meet it. And secondly, the view of BM itself as a system that expands from the organization to a network of interconnected activities and their associated value. It is within this view that NCP failed to grasp the full system. Though links with prominent research and funding bodies supported their mission and its achievement in line with stakeholders, overarching procurement policies, a requirement to their customers' purchasing decisions, were not evaluated. Within the inter-institutional system, organizational (meso) and institutional (macro) levels were still operating with a gap between values and established norms.

Finally, the thesis, including its research activities, and appended papers, meets its objective of contributing to a multilevel sustainability management theory through its development of a practical conceptual model and the application of BMfS as a conceptual frame. The theoretical contribution is built on the following foundations:

- Changing the perspective from the firm as the focal unit to the value network as the focal unit
- Recognizing that stakeholder management is not an add-on to existing organizational mandates and licenses to operate, but that long-term organizational sustainability requires the firm and its stakeholders be an integrated unit
- Using a BMfS to conceptualize organizational needs and objectives across levels of the inter-institutional system, and to map the ways certain mechanisms will support or hinder an organization's long-term sustainability goals
- The CapSEM model framework is one approach to support an organization in its ability to:
  - position itself in such multilevel system
  - practically identify and apply environmental and sustainability tools and methods to improve and report upon its sustainability performance
  - find a common vocabulary and conceptualization to discuss interwoven sustainability challenges with its stakeholders

In conjunction with these findings and its appended papers, the thesis finally asserts that though integrating existing management theories into a multilevel approach to sustainability management is valuable, a theory that sufficiently captures the complexity and urgency of sustainability cannot be a collection of their parts. While contributions to such approach were made in this study, more research is still required to explore and interpret the multiple systems in which organizations operate, and the tensions and value conflicts that result. An extensive scope, plethora of methods, and constant change and adaptation characterize sustainability management. Such makes it difficult to land on an overarching theory that has time to be empirically observed and tested before needing to be adapted again. Building the sustainability knowledge of organizations and recognizing the value of collaboration and capacity development around descriptive frameworks and methods may therefore be the most valuable and efficient approach to influencing holistic, multidimensional, and multilevel sustainability management in today's organizations.

7 References

Abdelkafi, N., Täuscher, K., 2016. Business Models for Sustainability from a System Dynamics Perspective. Organization and Environment 29, 74–96. https://doi.org/10.1177/1086026615592930

Adams, W.M., 2006. The future of sustainability: Re-thinking environment and development in the twenty-first century. IUCN: International Union for Conservation of Nature.

Allee, V., 2008. Value network analysis and value conversion of tangible and intangible assets. Journal of Intellectual Capital 9, 5–24. https://doi.org/10.1108/14691930810845777

Amit, R., Zott, C., 2012. Creating Value Through Business Model Innovation. MIT Sloan Management Review 53, 41–49.

Amit, R., Zott, C., 2001. Value creation in e-business. Strategic Management Journal. https://doi.org/10.1002/smj.187

Arrow, K., 1970. Political and Economic Evaluation of Social Effects and Externalities, in: The Analysis of Public Output. NBER, pp. 1–30.

Askeland, H., 2020. Institutional Leadership: Maintaining and Developing the 'Good' Organisation, in: Askeland, H., Espedal, G., Jelstad Løvaas, B., Sirris, S. (Eds.), Understanding Values Work: Institutional Perspectives in Organizations and Leadership. Springer International Publishing, Cham, pp. 139–158. https://doi.org/10.1007/978-3-030-37748-9_8

Askeland, H., Espedal, G., Jelstad Løvaas, B., Sirris, S. (Eds.), 2020. Understanding Values Work: Institutional Perspectives in Organizations and Leadership. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-030-37748-9

Bansal, P., 2005. Evolving sustainably: a longitudinal study of corporate sustainable development. Strategic Management Journal 26, 197–218. https://doi.org/10.1002/smj.441

Bansal, P., 2003. From Issues to Actions: The Importance of Individual Concerns and Organizational Values in Responding to Natural Environmental Issues. Organization Science 14, 510–527. https://doi.org/10.1287/orsc.14.5.510.16765

Bansal, P., 2002. The corporate challenges of sustainable development. AMP 16, 122–131. https://doi.org/10.5465/ame.2002.7173572

Bansal, P., Roth, K., 2000. Why Companies Go Green: A Model of Ecological Responsiveness. The Academy of Management Journal 43, 717–736. https://doi.org/10.2307/1556363

Barney, J.B., 1996. The Resource-Based Theory of the Firm. Organization Science 7, 469–469. https://doi.org/10.1287/orsc.7.5.469

Barney, J.B., 1991. Firm Resources and Sustained Competitive Advantage. Journal of Management 17, 99–120. https://doi.org/10.1177/014920639101700108

Baumgartner, R.J., Ebner, D., 2010. Corporate sustainability strategies: sustainability profiles and maturity levels. Sustainable Development 18, 76–89. https://doi.org/10.1002/sd.447

Baumgartner, R.J., Rauter, R., 2017. Strategic perspectives of corporate sustainability management to develop a sustainable organization. Journal of Cleaner Production, Systematic Leadership towards Sustainability 140, 81–92. https://doi.org/10.1016/j.jclepro.2016.04.146

Besharov, M., Khurana, R., 2015. Leading Amidst Competing Technical and Institutional Demands: Revisiting Selznick's Conception of Leadership, in: Research in the Sociology of Organizations. https://doi.org/10.1108/S0733-558X20150000044004

BH4S, 2022. About us [WWW Document]. Business Hub for Sustainability. URL https://bh4s.no/about-us (accessed 5.27.22).

Bidmon, C.M., Knab, S.F., 2018. The three roles of business models in societal transitions: New linkages between business model and transition research. Journal of Cleaner Production 178, 903–916. https://doi.org/10.1016/j.jclepro.2017.12.198

Bocken, N., 2021. Sustainable Business Models, in: Leal Filho, W., Azul, A.M., Brandli, L., Lange Salvia, A., Wall, T. (Eds.), Decent Work and Economic Growth, Encyclopedia of the UN Sustainable Development Goals. Springer International Publishing, Cham, pp. 963–975. https://doi.org/10.1007/978-3-319-95867-5_48

Bocken, N.M.P., Geradts, T.H.J., 2019. Barriers and drivers to sustainable business model innovation: Organization design and dynamic capabilities. Long Range Planning. https://doi.org/10.1016/j.lrp.2019.101950

Bocken, N.M.P., Rana, P., Short, S.W., 2015. Value mapping for sustainable business thinking. Journal of Industrial and Production Engineering 32, 88–102. https://doi.org/10.1080/21681015.2014.1000399

Bocken, N.M.P., Short, S.W., 2016. Towards a sufficiency-driven business model: Experiences and opportunities. Environmental Innovation and Societal Transitions 18, 41–61. https://doi.org/10.1016/j.eist.2015.07.010

Bocken, N.M.P., Short, S.W., Rana, P., Evans, S., 2014. A literature and practice review to develop sustainable business model archetypes. Journal of Cleaner Production 65, 42–56. https://doi.org/10.1016/j.jclepro.2013.11.039

Boons, F., Lüdeke-Freund, F., 2013. Business models for sustainable innovation: State-of-the-art and steps towards a research agenda. Journal of Cleaner Production 45, 9–19. https://doi.org/10.1016/j.jclepro.2012.07.007

Boons, F., Montalvo, C., Quist, J., Wagner, M., 2013. Sustainable innovation, business models and economic performance: An overview. Journal of Cleaner Production 45, 1–8. https://doi.org/10.1016/j.jclepro.2012.08.013

Brandt, P., Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J., von Wehrden, H., 2013. A review of transdisciplinary research in sustainability science. Ecological Economics 92, 1–15. https://doi.org/10.1016/j.ecolecon.2013.04.008

Bras, B., 1996. Current Educational Status, Interaction with Industry, and the Future of Sustainable Development (No. NTVA-report 2). The Norwegian Academy of Technological Science.

Brehmer, M., Podoynitsyna, K., Langerak, F., 2018. Sustainable business models as boundary-spanning systems of value transfers. Journal of Cleaner Production 172, 4514–4531. https://doi.org/10.1016/j.jclepro.2017.11.083

Breuer, H., Lüdeke-Freund, F., 2014. Normative Innovation for Sustainable Business Models in Value Networks.

Brundtland, G.H., 1987. Our Common Future: Report of the World Commission on Environment and Development (No. UN Document A/42/427). World Commission on Environment and Development.

Carayannis, E.G., Sindakis, S., Walter, C., 2015. Business Model Innovation as Lever of Organizational Sustainability. Journal of Technology Transfer 40, 85–104. https://doi.org/10.1007/s10961-013-9330-y

Carroll, A.B., 2015. Corporate social responsibility: The centerpiece of competing and complementary frameworks. Organizational Dynamics 44, 87–96. https://doi.org/10.1016/j.orgdyn.2015.02.002

Carroll, A.B., Laasch, O., 2020. From managerial responsibility to CSR and back to responsible management. Research Handbook of Responsible Management.

Casadesus-Masanell, R., Ricart, J.E., 2010. From strategy to business models and onto tactics. Long Range Planning 43, 195–215. https://doi.org/10.1016/j.lrp.2010.01.004

Chang, R.-D., Zuo, J., Zhao, Z.-Y., Zillante, G., Gan, X.-L., Soebarto, V., 2017. Evolving theories of sustainability and firms: History, future directions and implications for renewable energy research. Renewable and Sustainable Energy Reviews 72, 48–56. https://doi.org/10.1016/j.rser.2017.01.029

Chesbrough, H., 2010. Business model innovation: Opportunities and barriers. Long Range Planning 43, 354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Chesbrough, H., 2007. Why companies should have open business models. MIT Sloan Management Review. https://doi.org/10.1111/j.1540-5885.2008.00309_1.x

Collis, D.J., Montgomery, C.A., 1995. Competing on Resources: Strategy in the 1990s. Harvard Business Review.

Comin, L.C., Aguiar, C.C., Sehnem, S., Yusliza, M.-Y., Cazella, C.F., Julkovski, D.J., 2019. Sustainable business models: a literature review. Benchmarking: An International Journal 27, 2028–2047. https://doi.org/10.1108/BIJ-12-2018-0384

Conner, K.R., 1991. A Historical Comparison of Resource-Based Theory and Five Schools of Thought Within Industrial Organization Economics: Do We Have a New Theory of the Firm? Journal of Management 17, 121–154. https://doi.org/10.1177/014920639101700109

Cooper, D.R., Schindler, P.S., 2011. Business research methods. McGraw-Hill/Irwin.

Corley, K.G., Gioia, D.A., 2011. Building Theory about Theory Building: What Constitutes a Theoretical Contribution? AMR 36, 12–32. https://doi.org/10.5465/amr.2009.0486

Creswell, J.W., 2014. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE.

de Wit, B., Meyer, R., 2010. Strategy: Process, Content, Context: an International Perspective. Cengage Learning.

Delmas, M.A., Toffel, M.W., 2008. Organizational responses to environmental demands: opening the black box. Strategic Management Journal 29, 1027–1055. https://doi.org/10.1002/smj.701

Dembek, K., York, J., Singh, P.J., 2018. Creating value for multiple stakeholders: Sustainable business models at the Base of the Pyramid. Journal of Cleaner Production 196, 1600–1612. https://doi.org/10.1016/J.JCLEPRO.2018.06.046

Demil, B., Lecocq, X., 2010. Business model evolution: In search of dynamic consistency. Long Range Planning. https://doi.org/10.1016/j.lrp.2010.02.004

Dentchev, N., Baumgartner, R., Dieleman, H., Jóhannsdóttir, L., Jonker, J., Nyberg, T., Rauter, R., Rosano, M., Snihur, Y., Tang, X., van Hoof, B., 2016. Embracing the variety of sustainable business models: social entrepreneurship, corporate intrapreneurship, creativity, innovation, and other approaches to sustainability challenges. Journal of Cleaner Production 113, 1–4. https://doi.org/10.1016/j.jclepro.2015.10.130

Dentchev, N., Rauter, R., Jóhannsdóttir, L., Snihur, Y., Rosano, M., Baumgartner, R., Nyberg, T., Tang, X., van Hoof, B., Jonker, J., 2018. Embracing the variety of sustainable business models: A prolific field of research and a future research agenda. Journal of Cleaner Production 194, 695–703. https://doi.org/10.1016/J.JCLEPRO.2018.05.156

DiMaggio, P.J., Powell, W.W., 1983. The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. American Sociological Review 48, 147–160. https://doi.org/10.2307/2095101

Dopfer, K., Foster, J., Potts, J., 2004. Micro-meso-macro. J. Evol. Econ. 14, 263–279. https://doi.org/10.1007/s00191-004-0193-0

Drucker, P.F., 2002. The Discipline of Innovation. Harvard Business Review 10.

Durand, R., Thornton, P., 2018. Categorizing Institutional Logics, Institutionalizing Categories: A Review of Two Literatures. Academy of Management Annals.

Edwards, M., 2009. Organizational Transformation for Sustainability: An Integral Metatheory. Routledge, New York. https://doi.org/10.4324/9780203859933

Elkington, J., 2018. 25 Years Ago I Coined the Phrase "Triple Bottom Line." Here's Why It's Time to Rethink It. Harvard Business Review Digital Articles 2–5.

Elkington, J., 1998. Partnerships from cannibals with forks: The triple bottom line of 21st-century business. Environmental Quality Management 8, 37–51. https://doi.org/10.1002/tqem.3310080106

Escobar, L.F., Vredenburg, H., 2011. Multinational Oil Companies and the Adoption of Sustainable Development: A Resource-Based and Institutional Theory Interpretation of Adoption Heterogeneity. J Bus Ethics 98, 39–65. https://doi.org/10.1007/s10551-010-0534-x

Evans, S., Vladimirova, D., Holgado, M., Van Fossen, K., Yang, M., Silva, E.A., Barlow, C.Y., 2017. Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models. Business Strategy and the Environment 26, 597–608. https://doi.org/10.1002/bse.1939

Fet, A.M., 1997. Systems engineering methods and environmental life cycle performance with ship industry. Norwegian University of Science and Technology.

Fet, A.M., Knudson, H., 2021a. An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model). Sustainability 13, 4910. https://doi.org/10.3390/su13094910

Fet, A.M., Knudson, H., 2021b. Transdisciplinarity for sustainability management, in: Keitsch, M.M., Vermeulen, W.J.V. (Eds.), Transdisciplinarity for Sustainability, Routledge/ISDRS Series in Sustainable Development Research. Routledge.

Fobbe, L., Hilletofth, P., 2021. The role of stakeholder interaction in sustainable business models. A systematic literature review. Journal of Cleaner Production 327, 129510. https://doi.org/10.1016/j.jclepro.2021.129510

Foss, N.J., Saebi, T., 2018. Business models and business model innovation: Between wicked and paradigmatic problems. Long Range Planning 51, 9–21. https://doi.org/10.1016/j.lrp.2017.07.006

Foss, N.J., Saebi, T., 2017. Fifteen Years of Research on Business Model Innovation: How Far Have We Come, and Where Should We Go? Journal of Management 43, 200–227. https://doi.org/10.1177/0149206316675927

Foxon, T.J., Bale, C.S.E., Busch, J., Bush, R., Hall, S., Roelich, K., 2015. Low carbon infrastructure investment: extending business models for sustainability. Infrastructure Complexity 2, 4. https://doi.org/10.1186/s40551-015-0009-4

Frank, D.J., Hironaka, A., Schofer, E., 2000. The Nation-State and the Natural Environment over the Twentieth Century. American Sociological Review 65, 96. https://doi.org/10.2307/2657291

Freeman, E., Harrison, J.S., Wicks, A.C., Parmar, B.L., de Colle, S., 2010. Stakeholder theory: the state of the art. Cambridge University Press, Cambridge; New York.

Freeman, R.E., 2010. Strategic Management: A Stakeholder Approach. Cambridge University Press.

Freeman, R.E., 1984. Strategic Management: A Stakeholder Approach. Pitman.

Freeman, R.E., Wicks, A.C., Parmar, B., 2004. Stakeholder Theory and "The Corporate Objective Revisited." Organization Science 15, 364–369. https://doi.org/10.1287/orsc.1040.0066

Freudenreich, B., Lüdeke-Freund, F., Schaltegger, S., 2020. A Stakeholder Theory Perspective on Business Models: Value Creation for Sustainability. Journal of Business Ethics 166, 3–18. https://doi.org/10.1007/s10551-019-04112-z

Friedland, R., Alford, R., 1991. Bringing Society Back In: Symbols, Practices, and Institutional Contradictions.

Galbreath, J., 2018. Do Boards of Directors Influence Corporate Sustainable Development? An Attention-Based Analysis. Business Strategy and the Environment 27, 742–756. https://doi.org/10.1002/bse.2028

Gao, J., Bansal, P., 2013. Instrumental and Integrative Logics in Business Sustainability. J Bus Ethics 112, 241–255. https://doi.org/10.1007/s10551-012-1245-2

Garvare, R., Johansson, P., 2010. Management for sustainability – A stakeholder theory. Total Quality Management & Business Excellence 21, 737–744. https://doi.org/10.1080/14783363.2010.483095

Gaziulusoy, A.İ., Boyle, C., McDowall, R., 2013. System innovation for sustainability: a systemic double-flow scenario method for companies. Journal of Cleaner Production, Sustainable Innovation and Business Models 45, 104–116. https://doi.org/10.1016/j.jclepro.2012.05.013

Geels, F.W., 2011. The multi-level perspective on sustainability transitions: Responses to seven criticisms. https://doi.org/10.1016/j.eist.2011.02.002

Geels, F.W., Schot, J., 2007. Typology of sociotechnical transition pathways. Research Policy 36, 399–417. https://doi.org/10.1016/J.RESPOL.2007.01.003

Geissdoerfer, M., Vladimirova, D., Evans, S., 2018. Sustainable business model innovation: A review. Journal of Cleaner Production 198, 401–416. https://doi.org/10.1016/J.JCLEPRO.2018.06.240

Gherardi, S., Laasch, O., 2021. Responsible Management-as-Practice: Mobilizing a Posthumanist Approach. J Bus Ethics. https://doi.org/10.1007/s10551-021-04945-7

Giddings, B., Hopwood, B., O'Brien, G., 2002. Environment, economy and society: fitting them together into sustainable development. Sustainable Development 10, 187–196. https://doi.org/10.1002/sd.199

Gladwin, T.N., Kennelly, J.J., Krause, T.-S., 1995. Shifting Paradigms for Sustainable Development: Implications for Management Theory and Research. AMR 20, 874–907. https://doi.org/10.5465/amr.1995.9512280024

Glover, J.L., Champion, D., Daniels, K.J., Dainty, A.J.D., 2014. An Institutional Theory perspective on sustainable practices across the dairy supply chain. International Journal of Production Economics, Sustainable Food Supply Chain Management 152, 102–111. https://doi.org/10.1016/j.ijpe.2013.12.027

Greenwood, R., Oliver, C., Suddaby, R., Sahlin-Andersson, K. (Eds.), 2012. The SAGE Handbook of Organizational Institutionalism. SAGE Publications, London, UNITED KINGDOM.

Greenwood, R., Raynard, M., Kodeih, F., Micelotta, E., Lounsbury, M., 2011. Institutional Complexity and Organizational Responses. The Academy of Management Annals 5, 317–371. https://doi.org/10.1080/19416520.2011.590299

Greenwood, R., Suddaby, R., 2006. Institutional Entrepreneurship in Mature Fields: The Big Five Accounting Firms. The Academy of Management Journal 49, 27–48. https://doi.org/10.2307/20159744

Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., Öhman, M.C., Shyamsundar, P., Steffen, W., Glaser, G., Kanie, N., Noble, I., 2013. Policy: Sustainable development goals for people and planet. Nature 495, 305–307. https://doi.org/10.1038/495305a

Guba, E.G., Lincoln, Y.S., 1994. Competing paradigms in qualitative research, in: Handbook of Qualitative Research. pp. 105–117.

Hahn, T., Figge, F., Pinkse, J., Preuss, L., 2018. A Paradox Perspective on Corporate Sustainability: Descriptive, Instrumental, and Normative Aspects. J Bus Ethics 148, 235–248. https://doi.org/10.1007/s10551-017-3587-2

Hahn, T., Pinkse, J., Preuss, L., Figge, F., 2015. Tensions in Corporate Sustainability: Towards an Integrative Framework. Journal of Business Ethics 127, 297–316. https://doi.org/10.1007/s10551-014-2047-5

Hart, S.L., 1995. A Natural-Resource-Based View of the Firm. Source: The Academy of Management Review 20, 986–1014. https://doi.org/10.5465/AMR.1995.9512280033

Hart, S.L., Dowell, G., 2011. A natural-resource-based view of the firm: Fifteen years after. Journal of Management 37, 1464–1479. https://doi.org/10.1177/0149206310390219

Hart, S.L., Milstein, M.B., Caggiano, J., 1993. Creating Sustainable Value [and Executive Commentary]. The Academy of Management Executive 17, 56–69.

Hoffman, A.J., 1999. Institutional Evolution and Change: Environmentalism and the U.S. Chemical Industry. The Academy of Management Journal 42, 351–371. https://doi.org/10.2307/257008

Hörisch, J., Freeman, R.E., Schaltegger, S., 2014. Applying Stakeholder Theory in Sustainability Management: Links, Similarities, Dissimilarities, and a Conceptual Framework. Organization & Environment 27, 328–346. https://doi.org/10.1177/1086026614535786

Inigo, E.A., Albareda, L., Ritala, P., 2017. Business model innovation for sustainability: exploring evolutionary and radical approaches through dynamic capabilities. Industry and Innovation 24, 515–542. https://doi.org/10.1080/13662716.2017.1310034

Jahn, T., Bergmann, M., Keil, F., 2012. Transdisciplinarity: Between mainstreaming and marginalization. Ecological Economics 79, 1–10. https://doi.org/10.1016/j.ecolecon.2012.04.017

Jennings, P.D., Zandbergen, P.A., 1995. Ecologically Sustainable Organizations: An Institutional Approach. The Academy of Management Review 20, 1015–1052. https://doi.org/10.2307/258964

Jensen, M.C., Meckling, W.H., 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. Journal of Financial Economics 3, 305–360. https://doi.org/10.1016/0304-405X(76)90026-X

Joyce, A., Paquin, R.L., 2016. The triple layered business model canvas: A tool to design more sustainable business models. Journal of Cleaner Production 135, 1474–1486. https://doi.org/10.1016/j.jclepro.2016.06.067

Keitsch, M.M., 2012. Sustainable Design: A Brief Appraisal of its Main Concepts. Sustainable Development 20, 180–188. https://doi.org/10.1002/sd.1534

Kelemen, M., Rumens, N., 2012. Pragmatism and heterodoxy in organization research: Going beyond the quantitative/qualitative divide. International Journal of Organizational Analysis 20, 5–12. https://doi.org/10.1108/19348831211215704

Kelly, L.M., Cordeiro, M., 2020. Three principles of pragmatism for research on organizational processes. Methodological Innovations 13, 2059799120937242. https://doi.org/10.1177/2059799120937242

Kim, A., Kim, Y., Han, K., Jackson, S.E., Ployhart, R.E., 2017. Multilevel Influences on Voluntary Workplace Green Behavior: Individual Differences, Leader Behavior, and Coworker Advocacy. Journal of Management 43, 1335–1358. https://doi.org/10.1177/0149206314547386

Knudson, H., & Keitsch, M.M., 2023. 'Helping business contribute to a sustainability transition: Archetypes of business models for sustainability' in Fet, A.M. (ed.) Business transitions: A pathway to sustainability, Springer.

Kohtamäki, M., Vesalainen, J., Varamäki, E., Vuorinen, T., 2006. The governance of partnerships and a strategic network: Supplier actors' experiences in the governance by the customers. Management Decision 44, 1031–1051. https://doi.org/10.1108/00251740610690603

Koistinen, K., Laukkanen, M., Mikkilä, M., Huiskonen, J., Linnanen, L., 2018. Sustainable System Value Creation: Development of Preliminary Frameworks for a Business Model Change Within a Systemic Transition Process. pp. 105–127. https://doi.org/10.1007/978-3-319-73503-0_6

Kramer, M.R., Porter, M.E., 2011. Creating Shared Value. Harvard business review 3–17.

Kvale, S., 1996. Interviews: an introduction to qualitative research interviewing. Sage Publications.

Laasch, O., 2018. Beyond the purely commercial business model: Organizational value logics and the heterogeneity of sustainability business models. Long Range Planning 51, 158–183. https://doi.org/10.1016/J.LRP.2017.09.002

Laasch, O., Pinkse, J., 2020. Explaining the leopards' spots: Responsibility-embedding in business model artefacts across spaces of institutional complexity. Long Range Planning 53, 101891. https://doi.org/10.1016/j.lrp.2019.101891

Laasch, O., Suddaby, R., Freeman, R.E., Jamali, D., 2020. Mapping the emerging field of responsible management: domains, spheres, themes, and future research. Research Handbook of Responsible Management.

Lacy, P., Keeble, J., McNamara, Robert, 2014. Circular Advantage: Innovative Business Models and Technologies to Create Value in a World without Limits to Growth. Accenture.

Lan, L.L., Heracleous, L., 2010. Rethinking Agency Theory: The View from Law. AMR 35, 294–314. https://doi.org/10.5465/amr.35.2.zok294

Landrum, N.E., 2018. Stages of Corporate Sustainability: Integrating the Strong Sustainability Worldview. Organization & Environment 31, 287–313. https://doi.org/10.1177/1086026617717456

Leech, N.L., Onwuegbuzie, 2008. Recursivity, in: Given, L. (Ed.), The SAGE Encyclopedia of Qualitative Research Methods. SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States. https://doi.org/10.4135/9781412963909.n375

Lepak, D.P., Smith, K.G., Taylor, M.S., 2007. Value Creation and Value Capture: A Multilevel Perspective. AMR 32, 180–194. https://doi.org/10.5465/amr.2007.23464011

Lewandowski, M., 2016. Designing the Business Models for Circular Economy—Towards the Conceptual Framework. Sustainability 8, 43. https://doi.org/10.3390/su8010043

Lozano, R., Carpenter, A., Huisingh, D., 2015. A review of 'theories of the firm' and their contributions to Corporate Sustainability. Journal of Cleaner Production, Bridges for a more sustainable future: Joining Environmental Management for Sustainable Universities (EMSU) and the European Roundtable for Sustainable Consumption and Production (ERSCP) conferences 106, 430–442. https://doi.org/10.1016/j.jclepro.2014.05.007

Lüdeke-Freund, F., 2020. Sustainable entrepreneurship, innovation, and business models: Integrative framework and propositions for future research. Business Strategy and the Environment 29, 665–681. https://doi.org/10.1002/bse.2396

Lüdeke-Freund, F., Carroux, S., Joyce, A., Massa, L., Breuer, H., 2018. The sustainable business model pattern taxonomy—45 patterns to support sustainability-oriented business model innovation. Sustainable Production and Consumption 15, 145–162. https://doi.org/10.1016/j.spc.2018.06.004

Lüdeke-Freund, F., Dembek, K., 2017. Sustainable business model research and practice: Emerging field or passing fancy? Journal of Cleaner Production 168, 1668–1678. https://doi.org/10.1016/j.jclepro.2017.08.093

Lüdeke-Freund, F., Gold, S., Bocken, N.M.P., 2019. A Review and Typology of Circular Economy Business Model Patterns. Journal of Industrial Ecology 23, 36–61. https://doi.org/10.1111/jiec.12763

Lüdeke-Freund, F., Schaltegger, S., Dembek, K., 2019. Chapter 6: Strategies and drivers of sustainable business model innovation, in: Boons, F., McMeekin, A. (Eds.), Handbook of Sustainable Innovation.

Lusseau, D., Mancini, F., 2019. Income-based variation in Sustainable Development Goal interaction networks. Nat Sustain 2, 242–247. https://doi.org/10.1038/s41893-019-0231-4

Lynch, R., 2018. Strategic Management. Pearson UK.

Marczewska, M., Kostrzewski, M., 2020. Sustainable Business Models: A Bibliometric Performance Analysis. Energies 13, 6062. https://doi.org/10.3390/en13226062

Margolis, J.D., Walsh, J.P., 2003. Misery Loves Companies: Rethinking Social Initiatives by Business. Administrative Science Quarterly 48, 268–305. https://doi.org/10.2307/3556659

McCaslin, M.L., 2008. Pragmatism, in: Given, L.M. (Ed.), The Sage Encyclopedia of Qualitative Research Methods. Sage Publications, Los Angeles, Calif.

McGregor, S.L.T., 2017. Challenges of transdisciplinary collaboration: A conceptual literature review. Integral Leadership Review.

Meredith, J., 1993. Theory Building through Conceptual Methods. International Journal of Operations & Production Management 13, 3–11. https://doi.org/10.1108/01443579310028120

Meuer, J., Koelbel, J., Hoffmann, V.H., 2020. On the Nature of Corporate Sustainability. Organization & Environment 33, 319–341. https://doi.org/10.1177/1086026619850180

Meyer, J.W., Rowan, B., 1983. The structure of educational organizations, in: Meyer, J.W., Scott, W.R. (Eds.), Organizational Environments: Ritual and Rationality. SAGE Publications, Beverly Hills.

Meyer, J.W., Rowan, B., 1977. Institutionalized Organizations: Formal Structure as Myth and Ceremony. American Journal of Sociology 83, 340–363.

Miles, R.F., 1973. Systems Concepts: Lectures on Contemporary Approaches to Systems. J. Wiley.

Molina-Azorín, J.F., Pereira-Moliner, J., López-Gamero, M.D., Pertusa-Ortega, E.M., Tarí, J.J., 2019. Multilevel research: Foundations and opportunities in management. BRQ Business Research Quarterly. https://doi.org/10.1016/j.brq.2019.03.004

Montiel, I., Delgado-Ceballos, J., 2014. Defining and Measuring Corporate Sustainability: Are We There Yet? Organization & Environment 27, 113–139. https://doi.org/10.1177/1086026614526413

Montiel, I., Gallo, P.J., Antolin-Lopez, R., 2020. What on Earth Should Managers Learn About Corporate Sustainability? A Threshold Concept Approach. J Bus Ethics 162, 857–880. https://doi.org/10.1007/s10551-019-04361-y

Morris, M., Schindehutte, M., Allen, J., 2005. The entrepreneur's business model: Toward a unified perspective. Journal of Business Research. https://doi.org/10.1016/j.jbusres.2003.11.001

Nußholz, J.L.K., 2020. Circular business model design: business opportunities from retaining value of products and materials.

Ocasio, W., 1997. Towards an Attention-Based View of the Firm. Strategic Management Journal 18, 187–206. https://doi.org/10.1002/(SICI)1097-0266(199707)18:1+<187::AID-SMJ936>3.0.CO;2-K

Oliver, C., 1991. Strategic Responses to Institutional Processes. The Academy of Management Review 16, 145–179. https://doi.org/10.2307/258610

Osterwalder, A., 2004. The business model ontology a proposition in a design science approach (Doctoral Dissertation). Université de Lausanne, Faculté des hautes études commerciales.

Osterwalder, A., Pigneur, Y., 2010. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers, A handbook for visionaries, game changers, and challengers. https://doi.org/10.1523/JNEUROSCI.0307-10.2010

Parnell, J.A., 2008. Sustainable strategic management: construct, parameters, research directions. IJSSM 1, 35. https://doi.org/10.1504/IJSSM.2008.018125

Pieroni, M.P.P., McAloone, T.C., Pigosso, D.C.A., 2021. Circular economy business model innovation: Sectorial patterns within manufacturing companies. Journal of Cleaner Production 286, 124921. https://doi.org/10.1016/j.jclepro.2020.124921

Pieroni, M.P.P., McAloone, T.C., Pigosso, D.C.A., 2019. Business model innovation for circular economy and sustainability: A review of approaches. Journal of Cleaner Production 215, 198–216. https://doi.org/10.1016/j.jclepro.2019.01.036

Poole, M.S., Van de Ven, A.H., 1989. Using Paradox to Build Management and Organization Theories. AMR 14, 562–578. https://doi.org/10.5465/amr.1989.4308389

Popa, F., Guillermin, M., Dedeurwaerdere, T., 2015. A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science. Futures. https://doi.org/10.1016/j.futures.2014.02.002

Pradhan, P., 2019. Antagonists to meeting the 2030 Agenda. Nat Sustain 2, 171–172. https://doi.org/10.1038/s41893-019-0248-8

Pradhan, P., Costa, L., Rybski, D., Lucht, W., Kropp, J.P., 2017. A Systematic Study of Sustainable Development Goal (SDG) Interactions Earth's Future. Earth's Future 1169–1179. https://doi.org/10.1002/eft2.266

Preghenella, N., Battistella, C., 2021. Exploring business models for sustainability: A bibliographic investigation of the literature and future research directions. Business Strategy and the Environment. https://doi.org/10.1002/bse.2760

Proka, A., Beers, P.J., Loorbach, D., 2018. Transformative Business Models for Sustainability Transitions. Springer, Cham, pp. 19–39. https://doi.org/10.1007/978-3-319-73503-0_2

Pryshlakivsky, J., Searcy, C., 2013. Sustainable Development as a Wicked Problem, in: Kovacic, S.F., Sousa-Poza, A. (Eds.), Managing and Engineering in Complex Situations, Topics in Safety, Risk, Reliability and Quality. Springer Netherlands, Dordrecht, pp. 109–128. https://doi.org/10.1007/978-94-007-5515-4_6

Pucihar, A., Lenart, G., Kljajić Borštnar, M., Vidmar, D., Marolt, M., 2019. Drivers and Outcomes of Business Model Innovation—Micro, Small and Medium-Sized Enterprises Perspective. Sustainability 11, 344. https://doi.org/10.3390/su11020344

Quinn, R.E., 1988. Beyond rational management: Mastering the paradoxes and competing demands of high performance. Jossey-Bass, San Francisco, CA, US.

Radoynovska, N., Ocasio, W., Laasch, O., 2020. The emerging logic of responsible management: institutional pluralism, leadership, and strategizing. Research Handbook of Responsible Management.

Rauter, R., Jonker, J., Baumgartner, R.J., 2017. Going one's own way: drivers in developing business models for sustainability. Journal of Cleaner Production 140, 144–154. https://doi.org/10.1016/j.jclepro.2015.04.104

Richardson, J., 2008. The business model: an integrative framework for strategy execution. Strategic Change. https://doi.org/10.1002/jsc.821

Richmond, B., 1994. Systems thinking/system dynamics: Let's just get on with it. System Dynamics Review 10, 135–157. https://doi.org/10.1002/sdr.4260100204

Ritala, P., Huotari, P., Bocken, N., Albareda, L., Puumalainen, K., 2018. Sustainable business model adoption among S&P 500 firms: A longitudinal content analysis study. Journal of Cleaner Production 170, 216–226. https://doi.org/10.1016/j.jclepro.2017.09.159

Ritter, T., Lettl, C., 2018. The wider implications of business-model research. Long Range Planning. https://doi.org/10.1016/j.lrp.2017.07.005

Rivera, J., Oetzel, J., deLeon, P., Starik, M., 2009. Business Responses to Environmental and Social Protection Policies: Toward a Framework for Analysis. Policy Sciences 42, 3–32.

Robson, C., 2011. Real world research: a resource for users of social research methods in applied settings, 3. ed. ed. Wiley, Chichester.

Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F.S., Lambin, E., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H.J., Nykvist, B., de Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., Foley, J., 2009. Planetary boundaries: Exploring the safe operating space for humanity. Ecology and Society 14. https://doi.org/10.5751/ES-03180-140232

Russo, M.V., Fouts, P.A., 1997. A Resource-Based Perspective on Corporate Environmental Performance and Profitability. The Academy of Management Journal 40, 534–559. https://doi.org/10.2307/257052

Sachs, J., 2015. The age of sustainable development. Columbia University Press, New York.

Saebi, T., Lien, L., Foss, N.J., 2017. What Drives Business Model Adaptation? The Impact of Opportunities, Threats and Strategic Orientation. Long Range Planning 50, 567–581. https://doi.org/10.1016/j.lrp.2016.06.006

Sánchez-Teba, E.M., Benítez-Márquez, M.D., Bermúdez-González, G., Luna-Pereira, M. del M., 2021. Mapping the Knowledge of CSR and Sustainability. Sustainability 13, 10106. https://doi.org/10.3390/su131810106

Sarasini, S., Linder, M., 2018. Integrating a business model perspective into transition theory: The example of new mobility services. Environmental Innovation and Societal Transitions 27, 16–31. https://doi.org/10.1016/J.EIST.2017.09.004

Schaltegger, S., 2013. Sustainability Management, in: Idowu, S.O., Capaldi, N., Zu, L., Gupta, A.D. (Eds.), Encyclopedia of Corporate Social Responsibility. Springer, Berlin, Heidelberg, pp. 2384–2388. https://doi.org/10.1007/978-3-642-28036-8_741

Schaltegger, S., Beckmann, M., Hansen, E.G., 2013. Transdisciplinarity in Corporate Sustainability: Mapping the Field. Business Strategy and the Environment 22, 219–229. https://doi.org/10.1002/bse.1772

Schaltegger, S., Burritt, R., 2018. Business cases and corporate engagement with sustainability: Differentiating ethical motivations. Journal of Business Ethics 147, 241–259. https://doi.org/10.1007/s10551-015-2938-0

Schaltegger, S., Hansen, E.G., Lüdeke-Freund, F., 2016a. Business Models for Sustainability: Origins, Present Research, and Future Avenues. Organization and Environment 29, 3–10. https://doi.org/10.1177/1086026615599806

Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G., 2016b. Business Models for Sustainability: A Co-Evolutionary Analysis of Sustainable Entrepreneurship, Innovation, and Transformation. Organization and Environment 29, 264–289. https://doi.org/10.1177/1086026616633272

Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G., 2012a. Business cases for sustainability: the role of business model innovation for corporate sustainability. IJISD 6, 95. https://doi.org/10.1504/IJISD.2012.046944

Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G., 2012b. Business Cases for Sustainability and the Role of Business Model Innovation: Developing a Conceptual Framework. Ssrn. https://doi.org/10.2139/ssrn.2010506

Schaubroeck, J.M., Hannah, S.T., Avolio, B.J., Kozlowski, S.W.J., Lord, R.G., Treviño, L.K., Dimotakis, N., Peng, A.C., 2012. Embedding Ethical Leadership within and across Organization Levels. AMJ 55, 1053–1078. https://doi.org/10.5465/amj.2011.0064

Schwartz, M.S., Carroll, A.B., 2008. Integrating and Unifying Competing and Complementary Frameworks: The Search for a Common Core in the Business and Society Field. Business & Society 47, 148–186. https://doi.org/10.1177/0007650306297942

Scott, W.R., 2005. Institutional Theory: Contributing to a Theoretical Research Program, in: Smith, K.G., Hitt, M.A. (Eds.), Great Minds in Management: The Process of Theory Development. Oxford University Press, Oxford, UK.

Scott, W.R., 2001. Institutions and Organizations: Ideas and Interests, 2nd ed. SAGE Publications, Los Angeles, CA.

Scott, W.R., 1995. Institutions and Organizations: Ideas and Interests, 1st ed. SAGE Publications, Los Angeles, CA.

Scott, W.R., 1983. The organization of environments: Network, cultural and historical elements, in: Meyer, J.W., Scott, W.R. (Eds.), Organizational Environments: Ritual and Rationality. SAGE Publications, Beverly Hills.

Seddon, P.B., Lewis, G., Freeman, P., Shanks, G., 2004. 2 - Business models and their relationship to strategy, in: Currie, W.L. (Ed.), Value Creation from E-Business Models. Butterworth-Heinemann, Oxford, pp. 11–34. https://doi.org/10.1016/B978-075066140-9/50004-7

Selznick, P., 1957. Leadership in Administration.

Shafer, S.M., Smith, H.J., Linder, J.C., 2005. The power of business models. Business Horizons 48, 199–207. https://doi.org/10.1016/j.bushor.2004.10.014

Silvestre, W.J., Fonseca, A., Morioka, S.N., 2022. Strategic sustainability integration: Merging management tools to support business model decisions. Business Strategy and the Environment n/a. https://doi.org/10.1002/bse.3007

Simpson, B., 2018. Pragmatism: A Philosophy of Practice, in: The SAGE Handbook of Qualitative Business and Management Research Methods: History and Traditions. SAGE Publications Ltd, 1 Oliver's Yard, 55 City Road London EC1Y 1SP, pp. 54–68. https://doi.org/10.4135/9781526430212.n4

Sinkovics, N., Gunaratne, D., Sinkovics, R.R., Molina-Castillo, F.-J., 2021. Sustainable Business Model Innovation: An Umbrella Review. Sustainability 13, 7266. https://doi.org/10.3390/su13137266

Smith, W.K., Lewis, M.W., 2011. Toward a Theory of Paradox: A Dynamic equilibrium Model of Organizing. AMR 36, 381–403. https://doi.org/10.5465/amr.2009.0223

Smith, W.K., Tushman, M.L., 2005. Managing Strategic Contradictions: A Top Management Model for Managing Innovation Streams. Organization Science 16, 522–536.

Starik, M., Kanashiro, P., 2020. Advancing a Multi-Level Sustainability Management Theory, in: M. Wasieleski, D., Weber, J. (Eds.), Sustainability, Business and Society 360. Emerald Publishing Limited, pp. 17–42. https://doi.org/10.1108/S2514-175920200000004003

Starik, M., Kanashiro, P., 2013. Toward a Theory of Sustainability Management: Uncovering and Integrating the Nearly Obvious. Organization & Environment 26, 7–30. https://doi.org/10.1177/1086026612474958

Starik, M., Rands, G.P., 1995. Weaving an Integrated Web: Multilevel and Multisystem Perspectives of Ecologically Sustainable Organizations. The Academy of Management Review 20, 908–935. https://doi.org/10.2307/258960

Stebbins, R., 2001. Exploratory Research in the Social Sciences. https://doi.org/10.4135/9781412984249

Sterman, J.D., 1994. Learning in and about complex systems. System Dynamics Review 10, 291–330. https://doi.org/10.1002/sdr.4260100214

Stubbs, W., Cocklin, C., 2008. Conceptualizing a "sustainability business model." Organization and Environment 21, 103–127. https://doi.org/10.1177/1086026608318042

SustainAbility, 2014. Model behavior: 20 business model innovations for sustainability. SustainAbility.

Teece, D.J., 2010. Business models, business strategy and innovation. Long Range Planning 43, 172–194. https://doi.org/10.1016/j.lrp.2009.07.003

Thornton, P.H., 2004. Markets From Culture: Institutional Logics and Organizational Decisions in Higher Education Publishing. Stanford University Press. https://doi.org/10.1515/9781503619098

Thornton, P.H., Ocasio, W., 2012. Institutional Logics, in: Greenwood, R., Oliver, C., Suddaby, R., Sahlin-Andersson, K. (Eds.), The SAGE Handbook of Organizational Institutionalism. SAGE Publications Ltd, London, pp. 99–129. https://doi.org/10.4135/9781849200387

Tiemann, I., Fichter, K., 2016. Developing business models with the Sustainable Business Canvas: Manual for conducting workshops.

United Nations, 2021. Sustainable Development Goals Report 2021. United Nations, New York, NY.

United Nations, 2020. Sustainable Development Goals Report 2020. United Nations, New York, NY.

United Nations General Assembly, 2015. Transforming our world: The 2030 agenda for sustainable development. https://sustainabledevelopment.un.org/content/documents/7891Transforming%20Our%20World. pdf 1–5. https://doi.org/10.1007/s13398-014-0173-7.2

Upward, A., Jones, P., 2016. An Ontology for Strongly Sustainable Business Models: Defining an Enterprise Framework Compatible with Natural and Social Science. Organization and Environment 29, 97–123. https://doi.org/10.1177/1086026615592933

Van der Byl, C.A., Slawinski, N., 2015. Embracing Tensions in Corporate Sustainability: A Review of Research from Win-Wins and Trade-Offs to Paradoxes and Beyond. Organization & Environment 28, 54–79. https://doi.org/10.1177/1086026615575047

van Marrewijk, M., 2003. Concepts and Definitions of CSR and Corporate Sustainability: Between Agency and Communion. Journal of Business Ethics 44, 95–105. https://doi.org/10.1023/A:1023331212247

Vilanova, M., Lozano, J.M., Arenas, D., 2009. Exploring the Nature of the Relationship Between CSR and Competitiveness. J Bus Ethics 87, 57–69. https://doi.org/10.1007/s10551-008-9812-2

Vildåsen, S.S., Keitsch, M., Fet, A.M., 2017. Clarifying the Epistemology of Corporate Sustainability. Ecological Economics 138, 40–46. https://doi.org/10.1016/j.ecolecon.2017.03.029

Wade-Benzoni, K.A., Hoffman, A.J., Thompson, L.L., Moore, D.A., Gillespie, J.J., Bazerman, M.H., 2002. Barriers to Resolution in Ideologically Based Negotiations: The Role of Values and Institutions. AMR 27, 41–57. https://doi.org/10.5465/amr.2002.5922336

Wannags, L.L., Gold, S., 2020. Assessing tensions in corporate sustainability transition: From a review of the literature towards an actor-oriented management approach. Journal of Cleaner Production 264, 121662. https://doi.org/10.1016/j.jclepro.2020.121662

Wells, P.E., 2013. Business models for sustainability. Edward Elgar Pub. Ltd.

Whelan, T., Fink, C., 2016. The Comprehensive Business Case for Sustainability. Harvard Business Review.

Whetten, D.A., 1989. What Constitutes a Theoretical Contribution? The Academy of Management Review 14, 490–495. https://doi.org/10.2307/258554

Whiteman, G., Walker, B., Perego, P., 2013. Planetary Boundaries: Ecological Foundations for Corporate Sustainability. Journal of Management Studies 50, 307–336. https://doi.org/10.1111/j.1467-6486.2012.01073.x

Williams, A., Kennedy, S., Philipp, F., Whiteman, G., 2017. Systems thinking: A review of sustainability management research. Journal of Cleaner Production 148, 866–881. https://doi.org/10.1016/j.jclepro.2017.02.002

Yang, M., Evans, S., Vladimirova, D., Rana, P., 2017a. Value uncaptured perspective for sustainable business model innovation. Journal of Cleaner Production 140, 1794–1804. https://doi.org/10.1016/J.JCLEPRO.2016.07.102

Yang, M., Vladimirova, D., Evans, S., 2017b. Creating and Capturing Value Through Sustainability: The Sustainable Value Analysis Tool. Research-Technology Management 60, 30–39. https://doi.org/10.1080/08956308.2017.1301001

Zott, C., Amit, R., 2010. Business model design: An activity system perspective. Long Range Planning 43, 216–226. https://doi.org/10.1016/j.lrp.2009.07.004

Zott, C., Amit, R., Massa, L., 2011. The business model: Recent developments and future research. Journal of Management 37, 1019–1042. https://doi.org/10.1177/0149206311406265

Zucker, L.G., 1983. Organizations as institutions, in: Research in the Sociology of Organizations. JAI Press Inc., pp. 1–47.

8 Appendix: Papers included in the thesis

Paper		Status and ranking*
1	Fet, A.M. & Knudson, H. (2021a). An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model). *Sustainability*, 13.	Published 2021 (Level 1 journal)
2	Fet, A.M. & Knudson, H. (2021b). 'Transdisciplinarity in sustainability management' in Keitsch, M.M. & Vermuelen, W.J.V. (eds.) Transdisciplinarity for sustainability: Aligning diverse practices, Routledge/ ISDRS Series in Sustainable Development Research, Routledge, pp. 93-117.	Published 2020 (Level 2 book)
3	Knudson, H. & Keitsch, M.M. (2023). 'Helping business contribute to a sustainability transition: Archetypes of business models for sustainability' in Fet, A.M. (ed.) Business transitions: A pathway to sustainability, Springer.	Published 2023 (Level 1 book)
4	Knudson, H. (Conference paper). Examining institutional influences and values in sustainability management.	Presented at NORSI Conference, April 2022

*Rankings from the Norwegian publications list by the Norwegian Social Science Data Services (NSD)

Paper 1

Journal article:

"An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model)"

Annik Magerholm Fet and Haley Knudson

sustainability

MDPI

Article

An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model)

Annik Magerholm Fet [1,2,*] and Haley Knudson [2]

[1] Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, 7491 Trondheim, Norway
[2] Department of International Business, Norwegian University of Science and Technology, 6009 Ålesund, Norway; haley.knudson@ntnu.no
* Correspondence: annik.fet@ntnu.no

Abstract: A toolbox for assessing the environmental impacts of processes, products and services has been gradually developed over the last 30 years. The tools and methods place attention on a growing holistic concern to also consider stakeholders' views connected to impacts of the entire life cycle of products. Another change is the gradual increase in consideration of the economic and social dimensions of sustainability since the 1990s. This paper presents this development using two interlinked models that illustrate the changes from the scopes of time and system complexity. The two initial models are further merged into one, the Capacity-building in Sustainability and Environmental Management model (the CapSEM-model), which presents organizations a systemic way to transition to sustainability, seen from the scopes of system complexity and performance complexity. The CapSEM-model attempts to integrate the different dimensions of systems and of methodologies and their contribution to increased environmental and sustainability performance. The Sustainable Development Goals (SDGs) are further mapped onto the model as an example of how they can be useful in the transition to sustainability. The model is, therefore, a conceptualization and needs further development to specify accurate level boundaries. However, it has proven to be helpful for organizations that struggle to find a systematic approach toward implementing sustainability. This is described through a brief example from the manufacturing industry.

Keywords: environmental performance; management; sustainability; the SDGs; systems thinking; systems engineering; life cycle; capacity building in sustainability

Citation: Fet, A.M.; Knudson, H. An Approach to Sustainability Management across Systemic Levels: The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model). *Sustainability* **2021**, *13*, 4910. https://doi.org/10.3390/su13094910

Academic Editor: Cecilia Haskins

Received: 31 March 2021
Accepted: 23 April 2021
Published: 27 April 2021

1. Introduction

The focus on methodologies to assess environmental aspects and connected impacts has increased tremendously over the last 30 years [1–7]. *Our Common Future*, also known as the Brundtland Report, was launched in 1987 by the World Commission on Environment and Development (WCED), and importantly linked the needs of the environment and development for future agendas [8]. Presented at the 1992 Rio Conference, the report in many ways initiated the quest for sustainable development (SD) on an international scale. It was a catalyst for nations, as well as for large international corporations and smaller organizations, to take responsibility in addressing their sustainability challenges through management of their environmental impacts. Twenty years later, at Rio+20, the foundational ideas of the report continued to influence global SD initiatives, and the development of the United Nations (UN) Sustainable Development Goals (SDGs). Adopted in 2015, the SDGs [9] are the present global call to action for nations and companies alike. Progress, however, is not on track to reach all prescribed targets, and has been further curbed by the coronavirus disease 2019 (COVID-19) pandemic [10,11].

In addition to the competitive advantage that comes from increased environmental management and sustainability consciousness [12–15], companies of all sizes have a duty

to improve the sustainability of their organizations. They are an essential piece to solve the complex puzzle of global SD [10,11,16]. Nearly 35 years after the release of the Brundtland Report, this paper focuses especially on the environmental dimensions of SD. Furthermore, it presents the advances of life cycle based sustainability management tools over the period. It discusses how the tools relate to corporate practice, and how they have developed to expand thinking beyond firm level impacts to wider system level SD. It finally raises some critical questions to the extent the tools have advanced companies toward solving the challenges outlined in the SDGs.

To understand and manage the impacts of systems, the concepts of systems thinking and life cycle thinking are essential [17]. *Systems thinking* involves recognizing systems and subsystems, and the interactions within and between them, from a holistic perspective [18,19]. A *life cycle approach* to problem solving considers the material and resource inputs and resulting environmental, social and economic impacts across all phases of a product or service's life cycle [20]. It puts new demands on corporations as analytical requirements become increasingly complex, refined and demanding. In time, this will increase demand for specialized staff for monitoring and reporting. There is, in other words, a gap between the numerous and diverse analytical models for sustainability aspects, and organization capacity and practice. Furthermore, an overview of these methods and the knowledge needed to implement them is often lacking, especially in smaller companies with more limited resources [21]. As both internal and external requirements become more stringent to meet growing sustainability challenges, companies and organizations need a holistic toolbox to help them navigate the interacting systems of SD, from triple-bottom-line aspects, to geographic scope and long-term timelines.

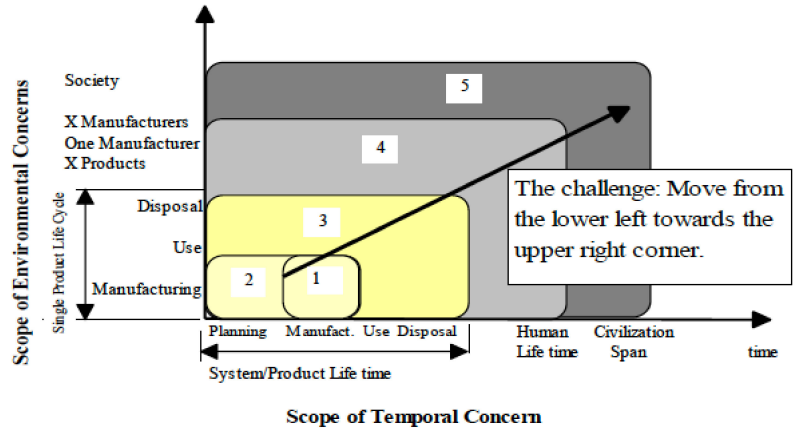
2. Meeting Sustainability Challenges with Life Cycle-Based Environmental and Sustainability Management Tools

To clarify the toolbox of life cycle-based environmental management tools, sustainability challenges can be classified according to the systems in which they occur. For example, from pollution and environmental degradation caused by production processes, to resource depletion and impacts across different stages of products' life cycles, to a lack of awareness from the management side of companies and policy makers.

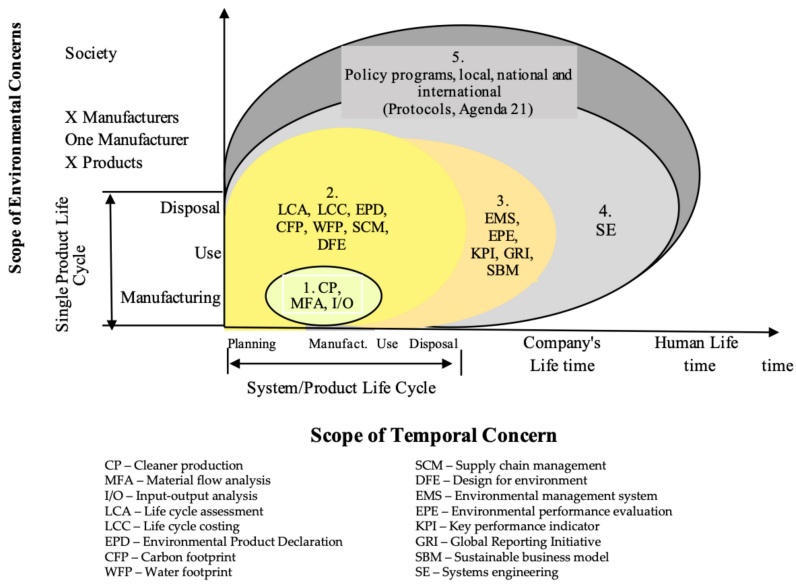
These challenges can be met by organizations with a combination of technological advancement and a change in procedures and strategies across different environmental performance levels that vary in temporal and environmental scope [22,23], for example:

1. Environmental engineering;
2. Pollution prevention;
3. Environmentally conscious design and manufacturing;
4. Industrial ecology; and
5. Sustainable development.

These environmental performance levels, or systems, are numbered and presented in Figure 1a and further explained in the following text. Several models for a systematic presentation of the development that has taken place since the early 1990s can be found in literature [24]. The models presented in Figure 1 are one way of illustrating the development of the field over time. They are also a way to demonstrate how the toolbox for environmental assessment and improvement can be used to assess the challenges of transitioning to sustainability and contributing to meeting the objectives set by the SDGs. Figure 1a, together with 1b, are the starting point of the Capacity-building in Sustainability and Environmental Management model (CapSEM-model), presented in Section 3. Each of the models has advanced the goal to guide companies and other organizations to systematically implement sustainability practices in their products and internal strategies while also building partnerships with the larger societal system.



(**a**)



(**b**)

Figure 1. (**a**) Classification of environmental performance levels, [23] modified after [22]; (**b**) a classification of methods and tools for environmental performance improvements, modified after [23,25].

Area 1 in Figure 1a represents the perspectives related to environmental engineering strategies to reduce negative environmental impacts within production and manufacturing processes. This space takes a limited systemic scope in both time and environmental concern (only during the manufacturing process and life cycle stage).

Area 2 increases the temporal scope and involves pre-planning for the manufacturing phase to prevent pollution and negative impacts during the process. Pollution prevention strategies arose in 1992 through the initiatives launched by the Environmental Protection Agency (EPA) [26], with the objective to reduce the environmental impacts of products by identifying them in the design phase. This way, the impacts throughout the life cycle could

be reduced through better planning of product design. For example, better planning might consider techniques for assembly and material selection to help avoid negative impacts in the use and dismantling phases later in the product's life cycle. So, even though this space has a limited system scope on planning and manufacturing only, it helps build an understanding of potential problems that may arise later in the life cycle. It can be seen as a prelude to the later consideration on the entire life cycle of a product.

Area 3 expands the scope from processes related to manufacturing to the product as a whole and considers design to reduce negative impacts across its complete life cycle. The increase in consciousness of environmental concerns is illustrated through the additional consideration of the use and disposal phases. The wider consciousness is also reflected in the expanding temporal scope related to the gradual knowledge development of how to address the entire life cycle of products [27].

Area 4 further broadens the system boundaries and understanding of impacts throughout the entire industrial system. This includes perspectives related to tracking material and energy flows according to principles of industrial ecology (IE), e.g., industrial symbioses and circular material flow models [28].

Finally, Area 5 represents the holistic consideration of environmental aspects over an extended timescale and beyond the firm and its network. This means considering aspects relevant for present and future generations and that address all stakeholders, and likely societal and political challenges over time.

Advancing Figure 1a, a model for a systematic approach to environmental performance improvements was developed [23,24]. This model is presented in Figure 1b and shows adaptations from the first model, most notably the addition of specific tools and methods for life cycle-based environmental assessment management mapped along environmental performance improvement levels.

Figure 1b suggests a series of environmental performance and management tools to be implemented for the purpose of moving to a higher level as indicated by Areas 1–5 presented in Figure 1a. The tools are further classified into a model for capacity building in sustainability and environmental management—the CapSEM-model. The application of the tools for the achievement of a transition towards sustainability is described in Figure 2. Readers should note that the models presented in Figure 1a and b focus mainly on environmental aspects of sustainability, and do not fully consider the needs of stakeholders and other social aspects. Systems engineering (SE) is, therefore, introduced as an overall process to better consider stakeholder opinions and involvement in a holistic transition process. SE can be viewed both as a discipline and as a process [23]. As a discipline, SE is about taking the holistic life cycle perspective and bringing in aspects from other disciplines when needed in a multidisciplinary context. SE as a process, is about bringing a system into being with an understanding of challenges to the system during its life cycle. A six-step SE-methodology is introduced by Fet [23], and suggests the following steps in the context of sustainability:

1. Identify stakeholders and their needs related to sustainability performance (of a system, hereunder also an organization or the society as a system);
2. Define the requirements for the achievements of stated needs;
3. Specify the current performances related to environmental, social and economic aspects;
4. Analyze and optimize the performances according to needs and requirements;
5. Suggest solutions according to stated needs and requirements;
6. Verify the suggested solutions against *1.* and *2.*

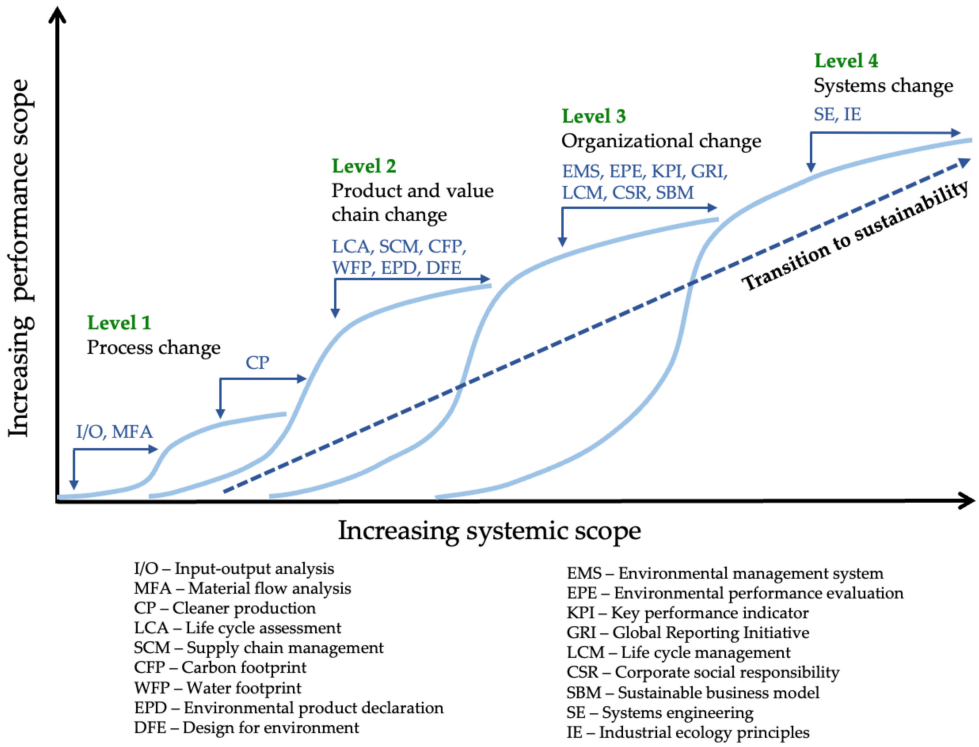


Figure 2. The Capacity-building in Sustainability and Environmental Management model (CapSEM-model)—a systemic approach towards sustainability, modified from [29].

This process can be used for each area in Figure 1. The complexity of stakeholder involvement, and thereby the sustainability aspects to be addressed along the road from the lowest to the higher levels, will increase. The steps in the SE-process can be performed in several cycles until the best solutions are achieved.

3. The Capacity-Building in Sustainability and Environmental Management Model (CapSEM-Model)

Based on the improvement of the models presented in Figure 1, the CapSEM-model was developed to illustrate the spectrum of environmental performance areas, here termed 'levels', ultimately reaching a holistic level of systemic sustainability. This requires that companies expand their environmental and sustainability management perspectives, extending the scope and number of impacts that are considered as they move toward more integrated sustainability. Figure 2 presents the CapSEM-model.

The waves in the CapSEM-model illustrate different levels of performance of the systems under study. A systematic use of the toolbox helps companies investigate the potential for appropriate actions to improve the environmental and sustainability performance related to production processes (Level 1), products and value chains (Level 2) and strategic organizational actions (Level 3). The highest level (Level 4) represents the larger societal system and a company's recognition of its place and responsibility within it. The term 'improvement' is used to mean the reduction of negative impacts and increase of, or replacement with, positive impacts—ultimately leading to strong, proactive and holistic sustainability as companies move toward the upper right of the model. As an organization traverses the levels, knowledge and tools from the previous levels are used as input to more extensive methods.

Each axis describes a change in scope. The horizontal axis shows the scope of systems and begins at the simple production process at Level 1. Furthermore, it extends to the set of processes within the value chain of a product at Level 2. Then, to the organizational level (Level 3), embracing concerns for production processes and products in addition to the integration of strategic management systems to implement sustainability consciousness in a more holistic manner. Within Level 3, aspects connected to economic and human factors should also be considered. The scope of the systems on Level 4 can be defined as the sector that the organization is a part of, or as wide as a societal system since all organizations are part of a larger system.

The vertical axis illustrates the scope of performance. Level 1 focuses on the environmental impacts of material flows, while in Level 2 the focus has broadened to the performance of the entire value chain where e.g., management of the supply-chain could contribute to an improvement of the value chain. Level 3 adds aspects to be considered from a strategic level, such as management systems that help organizations move to a higher level of performance over time. A broader range of sustainability aspects should also be considered at this level. Since Level 4 system scope depends on the context of the operation of the organization, a higher level of performance can be achieved under the holistic recognition of opportunities that come from improving system performance. From a systemic perspective, the different levels could be described as subsystems and system elements of a larger societal system.

As seen initially in Figure 1b, Area 1 contains the suggested tools of cleaner production (CP), material flow analysis (MFA) and input-output analyses (I/O) to monitor the environmental impacts during production and manufacturing processes. In the CapSEM-model, Level 1 encompasses process-related changes for environmental accounting and (more sustainable) performance (e.g., principles of eco-efficiency [30]). When setting objectives related to emissions, resource use and waste generation, companies must assess the current use and flows of materials in order to reduce consumption and waste in their production processes. The methods of I/O and MFA, therefore, fit in Level 1 as they measure baseline levels for defining improvement and resource efficiency [31]. CP is also located on this level, where source reduction is the objective rather than end-of-pipe solutions [32]—therefore moving its placement further along the scales of system scope and performance. The focus on resource efficiency is often driven by economic and/or policy incentives, as these methods provide for diagnostic comparison and benchmarking of companies. Focus only on environmental aspects means that the Level 1 system does not explicitly consider the wider impacts on society. Its system boundaries are drawn at the firm level around specific processes.

In Area 2 in Figure 1b, the tools for the purpose of environmentally conscious product development are life cycle assessment (LCA) [33], life cycle costing (LCC), supply chain management (SCM) [34], carbon footprint of products (CFP) and water footprint of products (WFP) [35], environmental product declaration (EPD) [36], and design for environment (DFE). By expanding from the boundaries of a single process, Level 2 in Figure 2 focuses on product- and value chain-related changes. This means a focus on a product or service and all activities and processes along its value chain. The methods in Level 2 include LCA, which quantifies material flows (from Level 1) across the full life cycle of a product. Results from an LCA are quantified and weighted in terms of environmental impact. The weighted criteria can then be used to implement changes for more sustainable SCM upstream in the value chain. In addition, the quantified impacts can be used to perform carbon- or water-foot printing of a product, or to reach certifications for acceptable levels of environmental impact, e.g., EPDs. The principles of DFE, e.g., design for recycling or dismantling, can transform the value chain, accounting and planning for reduced environmental impact through the full life cycle of the product and its materials. Social-life cycle assessment (S-LCA) could also be placed on Level 2, as a way to track social impacts through the life cycle of a product [37]. Such methods are younger in their methodological development and can be difficult to quantify. However, further developing both quantitative and qualitative

indicators to measure social sustainability impact is essential to reach holistic sustainability as mandated in the SDGs.

Area 3 in Figure 1b presents tools to be used by companies to improve their strategic approach for being more environmentally conscious, e.g., by implementing environmental management systems (EMS) [38], environmental performance evaluation (EPE), key performance indicators (KPI), the Global Reporting Initiative (GRI) [39], and sustainable business model (SBM) frameworks [40]. To further increase the comprehensiveness and scope of aspects considered, Level 3 moves toward the implementation of methods for stronger sustainability within an organization's management systems and strategy. The transition from Levels 1 and 2 into Level 3 represents an important advancement of management and monitoring for sustainability, allowing the incorporation of more social aspects. The organization must now widen its view beyond the firm itself, or its associated value chains, and track and report on its impacts in relation to the past, to its competitors, and for its long-term survival.

To make and monitor strategic changes across a company's operations, tools and methods for organization-level changes help address more complex sustainability challenges. Meeting these challenges might include establishing management systems to monitor goals for reducing negative environmental impacts and engaging further with stakeholders and customers. It also means looking beyond the value chain for effects of the organization on its employees and global and local environments in the long-term. Level 3 tools, therefore, include EPE, life cycle management (LCM) and EMS for benchmarking, meeting goals and continuous improvement (e.g., through ISO14001). Corporate social responsibility (CSR) embraces the triple bottom line of sustainability and is one approach to stakeholder engagement [41,42]. Establishing KPIs is an essential step in setting these goals, and companies can use a range of indicator frameworks from national systems to large, standardized reporting and communication systems such as the GRI. Methods from Levels 1 and 2 can be used to collect the data required for measuring the KPIs—demonstrating the knowledge development path represented by the CapSEM-model. SBMs are also placed on this level as they can help firms conceptualize their current value flows (environmental, economic and social) and identify areas to innovate for sustainability [43].

To achieve sustainable development in the long-term perspective, Areas 4 and 5 in Figure 1b present the policy programs and international regulations that help to set goals for a larger societal system. The highest level in the CapSEM-model, Level 4 also focuses on systems-related changes. This includes the most comprehensive assessment of sustainability aspects, both environmental and social, and for the company to see itself as one actor in a complex network of actors. While Levels 1-3 focus mainly on environmental aspects, Level 4 (and the higher degrees of the Level 3) command the inclusion of stakeholders and their long-term needs. Here, systems engineering (SE) is suggested as a helpful methodology to address these challenges and to include the principles of industrial ecology, e.g., principles of industrial symbioses and circularity [44].

Just as discussed in relation to Figure 1, the six-step SE methodology, can be performed at each level of the CapSEM-model until the most sustainable performance has been achieved. For simplicity, SE is placed at Level 4 to illustrate that it yields to the lower levels, but also because the increased scope required for Level 4 represents the most advanced form of SE.

To summarize, the CapSEM-model shows a spectrum of tools and methodologies for transitioning towards sustainability. It does not mandate that a company place itself within one level. Rather, it shows the way the tools and perspectives are linked and build upon each other. Additionally, it provides an example toolbox of methods that can be applied for improved sustainability in an organization depending on its level of ambition or maturity.

4. Adding the Sustainable Development Goals (SDGs) to the CapSEM-Model

The SDGs were established to guide the global sustainable development agenda until 2030. They are an extension of the previous global development framework, the

Millennium Development Goals (MDGs), which laid out an agenda for global poverty reduction. Recognizing the limitations of the MDGs, the SDGs were developed in a participatory process involving stakeholders across the global south and global north and introduced a set of specific targets and indicators for national governments to measure and communicate progress [45]. The SDGs have two aims—the reduction of global poverty and the halting of climate change, and chiefly recognize the link between the two. Criticisms of the triple-bottom-line approach, for example [46,47], suggest replacing environmental, social and economic silos with a more integrated view that sees the dimensions in a nested system for SD and the SDGs, respectively. These factors combine to make the SDGs a systemic framework that dictates the recognition of the interconnections between the goals and their targets. The set of 17 goals must be seen as a whole to achieve SD on the system level.

Although the official SDG target and indicator framework is for national governments, the agenda depends on industry participation and commitment. Many companies today use the SDGs to guide and communicate their sustainability strategies. A number of organizations provide guidelines and frameworks for use in companies to set goals and indicators within their strategies and operations. The SDG Compass [48], a joint initiative between the World Business Council for Sustainable Development (WBCSD), UN Global Compact and the GRI, is one such guideline, and provides databases of business tools and indicators openly accessible to companies. Nonetheless, it can be challenging to navigate the 17 goals and their respective indicators.

Just as the CapSEM-model helps make sense of the plethora of methods to measure sustainability performance by grouping them in levels, it can also help companies understand how their activities contribute to each of the SDGs. This logic is explained through the exemplification of a company in the manufacturing sector. Figure 3 places the SDGs along the CapSEM-model and discusses them in relation to each of the levels. Although the goals are each placed on a single level of the model, this is only used to illustrate an entry point to their application. In parallel to Rockström and Sukhdev's 'Wedding cake model of the SDGs' [47], SDGs 6, 13, 14 and 15 are grouped in the environmental layer, SDGs 1, 2, 3, 4, 5, 7, 11, 16 and 17 within the social layer, and SDGs 8, 9, 10 and 12 on the economic layer. Even though the SDGs can be systematized this way, we stress that the systemic nature of the SDG frameworks also requires that they are considered on all levels. However, to incorporate the SDGs into company strategies, specific goals and targets must be prioritized as a starting point [49].

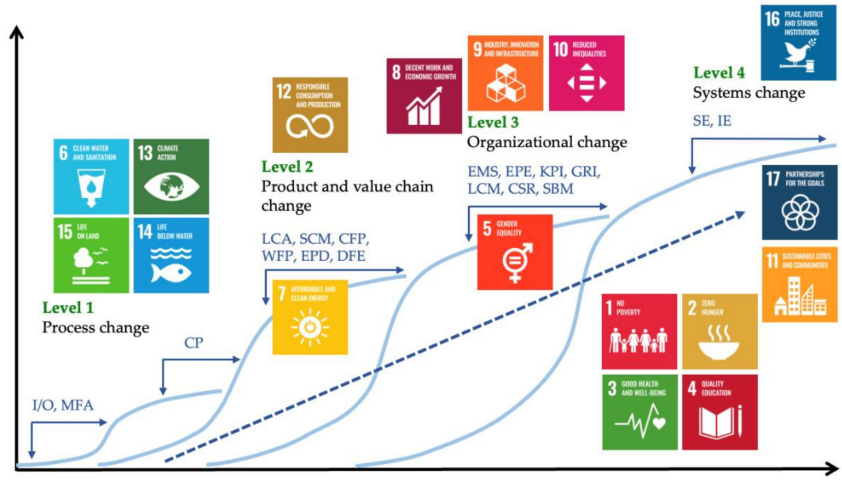


Figure 3. The CapSEM-model and the Sustainable Development Goals (SDGs), modified from [29].

Manufacturing involves several resource-consuming production processes (Level 1) where different materials, energy and chemicals are used, and resulting wastes generated. These wastes are typically disposed into air, land and water systems, and have contributed to the disruption of the Earth system. When considering improving sustainability in this sector, needs and requirements, therefore, include minimizing resource use, and avoiding pollution and the unnecessary expense and disposal of resources, especially into natural systems. I/O analyses can be used to quantify material flows within a production process or company system. Then, the quantified information can help inform decisions about the best solutions for designing new or adapting processes to reduce negative environmental impact. SDGs 6 (clean water), 13 (halting climate change), 14 (life under water) and 15 (life on land) have therefore been grouped on Level 1 in Figure 3 as their targets direct, for example, the increase in efficiency of water use (target 6.4) and the protection and restoration of water-related ecosystems (target 6.6). The selected goals and targets for improving sustainability in the manufacturing sector can be used to guide manufacturing companies in selecting indicators and making strategic decisions on how to reach them using the tools and methods at this level. The same process can be applied across the remaining levels and SDGs.

The move from Level 1 to Level 2 means that in addition to production processes, all other impacts related to the product and its value chain, e.g., the transportation of materials and components in the upstream life cycle of the product. In addition, downstream issues of distribution, maintenance and repair during the use phase and end of life treatment should be monitored for the entire life cycle of the product. Today, we see increased requirements for documentation of e.g., the carbon footprint of products. This means that the manufacturing company should take responsibility to achieve quantified information from the suppliers of materials, components and services across the life cycle. Based on the quantified information, optimized solutions for reduced GHG-emissions such as renewable energy sources should be achieved. SDGs 7 (clean energy) and 12 (responsible consumption and production) are therefore grouped on Level 2 to capture both upstream and downstream value chain sustainability improvements. SDG 12 places a focus on the entire value chain, and SDG 7 requires that products are designed and manufactured for cleaner energy systems. Because Level 1 can be seen as an input, or subsystem, to Level 2, the goals and targets at Level 1 must necessarily also be accounted for.

Pressure from public procurement and customer demands for products that support more sustainable living or help clean-up past damage, encourage manufacturing companies to report and communicate their progress toward improved sustainability. They must, therefore, develop their organizational strategies and practices (Level 3) in accordance with known guidelines and frameworks e.g., the SDGs. This requires trustful information from the companies across the other levels. For example, that all Level 1 processes are controlled and managed in a sustainable way, that systems for quantification of the carbon-footprints are in place at Level 2, and that the companies can present a management or certification system (e.g., ISO 14001) that supports the company in their annual assessment of improvements. The tools presented for Level 3, as well as Levels 1 and 2, should help the company to communicate the performance through a set of KPIs that give the stakeholders the information they need for an eventual approval of the sustainability performance or ranking of the company. SDGs 5 (gender equality) and 10 (reduced inequality) are placed on Level 3 and relate to the social aspects of e.g., equal employment and stakeholder inclusion to be mandated within the company's sustainability management systems and strategic organizational goals. SDGs 8 (decent work and economic growth) and 9 (industry, innovation and infrastructure) have also been grouped on the organizational level. This is because they pertain to the economic viability of a company and may further support its knowledge and innovation development relating to products that support a sustainable society.

Level 4 relates to the methods and tools that help drive systemic societal change and mandate the company view itself as one actor within a network of actors. SDGs 1 (no

poverty), 2 (zero hunger), 3 (good health and well-being) and 4 (quality education) are placed at this level as they represent the basic criteria for thriving livelihoods. Without meeting these livelihood goals, sustainability will not be reached or maintained over time. They also require that companies consider all stakeholders in their actions. SDGs 11 (sustainable cities and communities), 16 (peace, justice and strong institutions) and 17 (partnerships for goals) are also placed on this level as they help companies recognize their place in the larger system, from communities and cities, to regional, national and global impacts. In a smart and sustainable city system, for example, there are increasing requirements to document the carbon footprint of subsystems, from furniture used in public spaces and private homes, to infrastructure that is designed for easier repair and that supports smart renewable energy systems. The need for take-back systems and sharing economy systems will also appear more frequently, and IE is one of the tools for developing symbioses within a circular economy. Similarly, SE is an important tool for seeing systems and their interactions from a holistic perspective. Level 4 embraces the underlying features of Levels 1, 2 and 3.

It is common to see the cherry-picking of select SDGs that neatly meet ongoing operations, ignore interactions between them or fail to reflect upon the system as a whole [34]. Clear company strategy is, therefore, needed for prioritization of areas for sustainability improvement and related SDGs and targets. The authors do not claim that the ordering of SDGs in Figure 3 is the absolute placement, but rather that it is one way to help a company identify the ways their operations initially relate to each goal. If companies better understand and engage with the goals, their ability to prioritize and make strong measurable contributions to their targets increases [49,50].

5. Discussion

The CapSEM-model demonstrates how the different dimensions of systems and of methodologies can be integrated to contribute to increased environmental and sustainability performance. Transitions can be achieved within organizations through the use of the tools presented first in Figure 1b and advanced since the early 1990s. The SDGs are further mapped onto the model as an example of how they can be useful in the transition to sustainability as entry-points to and objectives for action. The models in Figure 1a,b have their roots in the initiatives that were introduced in the 1990s. Work towards improved environmental consciousness in organizations has advanced since clean-up and pollution prevention were the main strategies. Over this period, a set of methodologies were developed and matured. For example, early versions of CP have contributed to the further development of standards for EPE and EMS. Similarly, the first versions of LCA were the foundation of other tools such as WFP, CFP, EPD and DFE, and the inclusion of the social dimension in S-LCA. Other tools have come later, or new versions of early pilots have been further developed under new names. The GRI framework is one such example. While indicators and reporting schemes were initially developed by different bodies, the GRI is now used as a common concept for reporting-systems and the use of performance indicators across different sectors. As methods and tools continue to be advanced, and new approaches or frameworks are initiated, the CapSEM-model will need to be updated to reflect changes in the toolbox and outlooks of organizations. The list of methods presented in the model is not exhaustive since new supportive tools are under continuous development.

Numerous scholars have suggested categorizations of environmental performance and sustainability methods (e.g., [51–53]). The CapSEM-model, however, classifies analytical methods and tools in a practical way that can serve as an entry- or positioning point for companies. Its development has paralleled the historical growth in concern for the environment and is a result of engagement with companies of various maturity levels and outlooks over the period.

As an organization moves between levels, tensions or limitations may be identified in relation to requirements or assumptions in methods at other levels. This may be due

to the limited scope of certain methods that are unable to capture aspects across all SD dimensions. In many cases, tough decisions must be made between sustainability trade-offs and require that the organization has a clear strategy to guide their priorities.

In further research the CapSEM-model should be tested across different sectors and the different dimensions of sustainability. The systems studied at each level in the CapSEM-model should also be further described as they appear as different categories of systems, either as physical systems (e.g., production processes), theoretical systems (e.g., management systems), or geographical systems (e.g., for a societal study). Further development of the model is, therefore, encouraged, under a systematic approach to stakeholder involvement and actions for checking the achievements of initially formulated needs and requirements.

6. Conclusions

The purpose of this paper has been twofold. First, to illustrate how different initiatives of environmental consciousness and related monitoring and management tools have been developed over time and can be further systematized for the purpose of environmental and sustainability performance improvements at different system levels. Second, the paper demonstrates how these tools can be used in a systematic way for organizations in their transition to sustainability.

No matter what is the driver of sustainability improvement within an organization, SD is a wicked and complex problem (e.g., [54–56]), that requires transdisciplinary, collaborative and holistic thinking across triple-bottom-line principles, long-term systemic reasoning and wide stakeholder involvement. The CapSEM-model is a conceptualization of methods and approaches to help companies address this problem, and to identify opportunities within it. Although the CapSEM-model needs further development to specify accurate level boundaries, it has proven to be helpful for organizations that struggle to find a systematic approach toward implementing sustainability.

Author Contributions: Conceptualization, A.M.F. and H.K.; methodology, A.M.F.; writing—original draft preparation, A.M.F. and H.K.; writing—review and editing, A.M.F. and H.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Hunt, C.B.; Auster, E.R. Proactive environmental management: Avoiding the toxic trap. *MIT Sloan Manag. Rev.* **1990**, *31*, 7–18.
2. Colby, M.E. Environmental management in development: The evolution of paradigms. *Ecol. Econ.* **1991**, *3*, 193–213. [CrossRef]
3. Dillon, P.S.; Fischer, K. *Environmental Management in Corporations: Methods and Motivations*; Center for Environmental Management, Tufts University: Medford, MA, USA, 1992.
4. Welford, R.; Gouldson, A. *Environmental Management & Business Strategy*; Pitman Publishing Limited: London, UK, 1993.
5. Sarkis, J. Manufacturing strategy and environmental consciousness. *Technovation* **1995**, *2*, 79–97. [CrossRef]
6. Berry, M.A.; Rondinelli, D.A. Proactive corporate environmental management: A new industrial revolution. *Acad. Manag. Perspect.* **1998**, *12*, 38–50. [CrossRef]
7. Soo Wee, Y.; Quazi, H.A. Development and validation of critical factors of environmental management. *Ind. Manag. Data Syst.* **2005**, *105*, 96–114. [CrossRef]
8. World Commission on Environment and Development (WCED). *Our Common Future*; Oxford University Press: Oxford, UK, 1987.
9. UN General Assembly. Transforming our world: The 2030 agenda for sustainable development. In Proceedings of the United Nations Summit, New York, NY, USA, 25–27 September 2015; Available online: https://sustainabledevelopment.un.org/post2015/transformingourworld/publication (accessed on 22 March 2021).
10. United Nations. *Sustainable Development Goals Report 2020*; United Nations: New York, NY, USA, 2020; Available online: https://unstats.un.org/sdgs/report/2020/The-Sustainable-Development-Goals-Report-2020.pdf (accessed on 22 March 2021).

11. Sachs, J.; Schmidt-Traub, G.; Kroll, C.; Lafortune, G.; Fuller, G.; Woelm, F. *Sustainable Development Report 2020: The Sustainable Development Goals and Covid-19*; Cambridge University Press: Cambridge, UK, 2020; Available online: https://sdgindex.org/reports/sustainable-development-report-2020/ (accessed on 22 March 2021).
12. Porter, M.E.; Van der Linde, C. Toward a new conception of the environment-competitiveness relationship. *J. Econ. Perspect.* **1995**, *9*, 97–118. [CrossRef]
13. Porter, M.E.; Van der Linde, C. *Green and Competitive: Ending the Stalemate*; Harvard Business Review: Brighton, MA, USA, 1995; pp. 119–134.
14. Klassen, R.D.; McLaughlin, C.P. The impact of environmental management on firm performance. *Manag. Sci.* **1996**, *42*, 1093–1227. [CrossRef]
15. Melnyk, S.A.; Sroufe, R.P.; Calantone, R. Assessing the impact of environmental management systems on corporate and environmental performance. *J. Oper. Manag.* **2003**, *21*, 329–351. [CrossRef]
16. Schaltegger, S.; Hansen, E.G.; Lüdeke-Freund, F. Business models for sustainability: Origins, present research, and future avenues. *Organ. Environ.* **2016**, *29*, 3–10. [CrossRef]
17. Fet, A.M. Environmental management and corporate social responsibility. *Clean Technol. Environ. Policy* **2006**, *8*, 217–218. [CrossRef]
18. Richmond, B. Systems thinking: Critical thinking skills for the 1990s and beyond. *Syst. Dyn. Rev.* **1993**, *9*, 113–133. [CrossRef]
19. Richmond, B. The "thinking" in systems thinking: How can we make it easier to master. *Syst. Think.* **1997**, *8*, 1–5. Available online: https://thesystemsthinker.com/the-thinking-in-systems-thinking-how-can-we-make-it-easier-to-master/ (accessed on 18 April 2021).
20. Rebitzer, G.; Ekvall, T.; Frischknecht, R.; Hunkeler, D.; Norris, G.; Rydberg, T.; Schmidt, W.P.; Suh, S.; Weidema, B.P.; Pennington, D.W. Life cycle assessment part 1: Framework, goal and scope definition, inventory analysis, and applications. *Environ. Int.* **2004**, *30*, 701–720. [CrossRef] [PubMed]
21. Perez-Sanchez, D.; Barton, J.R.; Bower, D. Implementing environmental management in SMEs. *Corp. Soc. Responsib. Environ. Manag.* **2003**, *10*, 67–77. [CrossRef]
22. Bras, B. Current educational status, interaction with industry, and the future of sustainable development. In *NTVA-Report 2: Industrial Ecology and Sustainable Product Design*; The Norwegian Academy of Technological Science: Trondheim, Norway, 1996.
23. Fet, A.M. Systems Engineering Methods and Environmental Life Cycle Performance within Ship Industry. Ph.D. Thesis, Norwegian University of Science and Technology, Trondheim, Norway, 1997.
24. Fet, A.M. Environmental management tools and their application: A review with references to case studies. In *Knowledge for Inclusive Development: International Series on Technology Policy and Innovation*; Conceição, P., Gibson, D.V., Heitor, M.V., Sirilli, G., Veloso, F., Eds.; Quorum Books, Greenwood Publishing Group: Westport, CT, USA, 2002; pp. 449–464.
25. Fet, A.M.; Aspen, D.M.; Ellingsen, H. Systems engineering as a holistic approach to life cycle designs. *Ocean Eng.* **2013**, *62*, 1–9. [CrossRef]
26. Environmental Protection Agency. *Facility Pollution Prevention Guide*; Environmental Protection Agency's Office of Solid Waste: Washington, DC, USA; The Risk Reduction Engineering Laboratory: Cincinnati, OH, USA, 1992.
27. Ehrenfeld, J.R. Industrial ecology: A strategic framework for product policy and other sustainable practices. In Proceedings of the Green Goods: The Second International Conference and Workshop on Product Oriented Policy, Stockholm, Sweden, September 1994.
28. Graedel, T.E.; Allenby, B.R. *Industrial Ecology*; Prentice Hall: Hoboken, NJ, USA, 1995.
29. Fet, A.M.; Knudson, H. Transdisciplinarity for sustainability management. In *Transdisciplinarity for Sustainability: Aligning Diverse Practices*; Keitsch, M., Vermeulen, W., Eds.; Routledge: London, UK, 2021; pp. 93–117.
30. Fet, A.M. Eco-efficiency reporting exemplified by case studies. *Clean Technol. Environ. Policy* **2003**, *5*, 232–240. [CrossRef]
31. Bringezu, S.; Moriguchi, Y. Material flow analysis. In *A Handbook of Industrial Ecology*; Ayres, R.U., Ayres, L.W., Eds.; Edward Elgar Publishing Limited: Cheltenham, UK, 2002; pp. 79–91.
32. Jackson, T. *Clean Production Strategies: Developing Preventative Environmental Management in the Industrial Economy*; Lewis Publishers: Boca Raton, FL, USA, 1993.
33. Nordic Council of Ministers. Product Life Cycle Assessment–Principles and Methodology. In *Proceedings of Nord 1992: 9th*; Nordic Council of Ministers: Copenhagen, Denmark, 1992.
34. Igarashi, M.; De Boer, L.; Fet, A.M. What is required for greener supplier selection? A literature review and conceptual model development. *J. Purch. Supply Manag.* **2013**, *9*, 247–263. [CrossRef]
35. Fet, A.M.; Panthi, L. Standards on carbon and water footprints and their implications for the maritime sector. In Proceedings of the International Conference on Maritime Technology, Harbin, China, 25–28 June 2012.
36. Fet, A.M.; Skaar, C.; Michelsen, O. Product category rules (PCR) and environmental product declarations (EPD) as tools to promote sustainable products. *Clean Technol. Environ. Policy* **2009**, *11*, 201–207. [CrossRef]
37. Huertas-Valdivia, I.; Ferrari, A.M.; Settembre-Blundo, D.; García-Muiña, F. Social life-cycle assessment: A review by bibliometric analysis. *Sustainability* **2020**, *12*, 6211. [CrossRef]
38. Fet, A.M.; Knudson, H. Environmental management from a systems perspective. In *Encyclopedia of Sustainable Technologies*, 1st ed.; Abraham, M.A., Ed.; Elsevier: Amsterdam, The Netherlands, 2017; pp. 165–173.
39. Fet, A.M.; Staniškis, J.K.; Arbačiauskas, V. Indicators and reporting as a driving tool for environmental activities in the region. *Environ. Res. Eng. Manag.* **2009**, *1*, 69–75.

40. Joyce, A.; Paquin, R.L. The triple layered business model canvas: A tool to design more sustainable business models. *J. Clean. Prod.* **2016**, *135*, 1474–1486. [CrossRef]
41. Skaar, C.; Fet, A.M. Accountability in the value chain: From Environmental Product Declaration (EPD) to CSR Product Declaration. *Corp. Soc. Responsib. Environ. Manag.* **2012**, *19*, 228–239. [CrossRef]
42. Carson, S.G.; Fet, A.M.; Skaar, C. A Nordic Perspective of Corporate Social Responsibility (CSR). *Etikk Praksis Nord J. Appl. Ethics* **2011**, *5*, 3–8. [CrossRef]
43. Evans, S.; Vladimirova, D.; Holgado, M.; Van Fossen, K.; Yang, M.; Silva, E.A.; Barlow, C.Y. Business model innovation for sustainability: Towards a unified perspective for creation of sustainable business models. *Bus. Strategy Environ.* **2017**, *26*, 597–608. [CrossRef]
44. Sopha, B.; Fet, A.M.; Keitsch, M.; Haskins, C. Using systems engineering to create a framework for evaluating industrial symbiosis options. *Syst. Eng.* **2010**, *13*, 149–160. [CrossRef]
45. UN General Assembly. Annex: Global indicator framework for the sustainable development goals and targets of the 2030 agenda for sustainable development. In *Resolution Adopted by the General Assembly on Work of the Statistical Commission pertaining to the 2030 Agenda for Sustainable Development (A/RES/71/313)*; UN General Assembly: New York, NY, USA, 2017; Available online: https://undocs.org/A/RES/71/313 (accessed on 22 March 2021).
46. Griggs, D.; Stafford-Smith, M.; Gaffney, O.; Rockström, J.; Öhman, M.C.; Priya, S.; Steffen, W.; Glaser, G.; Kanie, N.; Noble, I. Sustainable development goals for people and planet. *Nature* **2013**, *495*, 305–307. [CrossRef]
47. Rockström, J.; Sukhdev, P. Opening Keynote Speech. In Proceedings of the Presentation at the Stockholm EAT Food Forum, Stockholm, Sweden, 13–14 June 2016.
48. Global Reporting Initiative (GRI); UN Global Compact; World Business Council for Sustainable Development (WBCSD). SDG Compass: The Guide for Business Action on the SDGs. Available online: https://sdgcompass.org/ (accessed on 22 March 2021).
49. GRI; UN Global Compact. Integrating the SDGs into Corporate Reporting: A Practical Guide. Business Reporting on the SDGs, GRI and UN Global Compact. 2018. Available online: https://d306pr3pise04h.cloudfront.net/docs/publications%2FPractical_Guide_SDG_Reporting.pdf (accessed on 22 March 2021).
50. Mhlanga, R.; Gneiting, U.; Agarwal, N. Walking the talk: Assessing companies' progress from SDG rhetoric to action. In *Oxfam Discussion Paper*; Oxfam International: Oxford, UK, 2018. [CrossRef]
51. Robèrt, K.H.; Schmidt-Bleek, B.; Aloisi de Larderel, J.; Basile, G.; Jansen, J.L.; Kuehr, R.; Price Thomas, P.; Suzuki, M.; Hawken, P.; Wackernagel, M. Strategic sustainable development: Selection, design and synergies of applied tools. *J. Clean. Prod.* **2002**, *10*, 197–214. [CrossRef]
52. Singh, R.K.; Murty, H.R.; Gupta, S.K.; Dikshit, A.K. An overview of sustainability assessment methodologies. *Ecol. Indic.* **2009**, *9*, 189–212. [CrossRef]
53. Mura, M.; Longo, M.; Micheli, P.; Bolzani, D. The evolution of sustainability measurement research. *Int. J. Manag. Rev.* **2018**, *20*, 661–695. [CrossRef]
54. Lang, D.J.; Wiek, A.; Bergmann, M.; Stauffacher, M.; Martens, P.; Moll, P.; Swilling, M.; Thomas, C.J. Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustain. Sci.* **2012**, *7*, 25–43. [CrossRef]
55. Brandt, P.; Ernst, A.; Gralla, F.; Luederitz, C.; Lang, D.J.; Newig, J.; Reinart, F.; Abson, D.J.; Von Wehrden, H. A review of transdisciplinary research in sustainability science. *Ecol. Econ.* **2013**, *92*, 1–15. [CrossRef]
56. Schaltegger, S.; Beckmann, M.; Hansen, E.G. Transdisciplinarity in corporate sustainability: Mapping the field. *Bus. Strategy Environ.* **2013**, *22*, 219–229. [CrossRef]

Paper 2

Book Chapter:

"Transdisciplinarity for sustainability management"

Annik Magerholm Fet and Haley Knudson

Transdisciplinarity For Sustainability

Aligning Diverse Practices

Edited by Martina M. Keitsch and Walter J.V. Vermeulen

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

earthscan
from Routledge

First published 2021
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
52 Vanderbilt Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record for this book has been requested

ISBN: 978-0-367-18907-5 (hbk)
ISBN: 978-0-429-19912-7 (ebk)

Typeset in Times New Roman
by Apex CoVantage, LLC

6 Transdisciplinarity for sustainability management

Annik M. Fet and Haley Knudson

6.1 Introduction

Sustainability embodies the defining characteristics of a wicked problem, and enabling sustainable transformations in ecological, social and economic systems therefore becomes a definitively transdisciplinary problem due to the complexities, interactions and multiple perspectives essential to its solution (Brandt et al., 2013). In this chapter, transdisciplinarity (TD) is defined as a 'critical and self-reflexive research approach that relates societal with scientific problems; it produces new knowledge by integrating different scientific and extra-scientific insights; its aim is to contribute to both societal and scientific progress' (Jahn et al., 2012, p. 8). Further, the chapter recognizes the special qualities of TD collaboration, including its focus on wicked problems; need for a collaborative problem definition and group approach with team members with diverse views; and a resulting synthesis of integrated and reflexive knowledge (McGregor, 2017).

This chapter describes two aspects of a transdisciplinary capacity building (CB) project between universities and local stakeholders in Norway, the Netherlands, Portugal, India, Nepal and Uganda. These aspects are, first, the *project implementation process* and, second, a *stepwise model* of tools that companies can follow to learn and implement sustainability and environmental management strategies into different operational levels. After the interuniversity project, Capacity building in Sustainability and Environmental Management (CapSEM), is briefly introduced in section 6.2, the stepwise model is presented in section 6.3. Then, section 6.4 discusses project activities in relation to Jahn et al.'s (2012) ideal three-phase TD process and reflects upon strengths and challenges in both project implementation and fostering transdisciplinarity and deliverable achievement in its context of multiple cultures, EU funding rules and varying levels of sustainability maturity between university partners. The stepwise model was used to guide project development and activities surrounding curriculum development and knowledge-sharing and -implementation in universities and in local industry case studies in Uganda, India and Nepal. It has also helped facilitate TD case-study examples in Portugal, the Netherlands and Norway. Section 6.5 expands specifically on the way the stepwise model enables multi-stakeholder and multi-disciplinary engagement leading to a TD approach to sustainability management.

Industrial case-examples from the project partners are presented as examples in section 6.6, along with an example of how the United Nations Sustainable Development Goals (SDGs) (United Nations General Assembly, 2015) can be mapped along the stepwise model for facilitated communication with industry. Section 6.7 provides concluding remarks about the role of TD in both the project and stepwise model, along with considerations for how to overcome some of the challenges from the process.

The case presented in the chapter represents the 'taste' of *small-range TD*, as outlined in Chapter 2 of this book, as it includes the explicit link to non-academic actors and their needs, but has not yet had the time to become more empowering for involved stakeholders. Although the involvement of stakeholder and industry partners in the project was not mandated, it is essential within the fields of environmental and sustainability management, which depend on companies as the object of study. Within the project time frame, however, collaboration mainly surrounded university–university interaction with industry partnerships as a component, and began to move into reflexive university–stakeholder/industry collaboration towards the end of the project. For impact to transition further from environmental management of companies (a part of the solution) to the solution of complex societal sustainability problems, wider involvement of and direction from stakeholders is required. The TD impact for transformation may therefore be minimal or 'small-range' at this stage, with limits to the mutual creation of knowledge and its wider transformational effect due to the recognized limitations of time and resources (Stokols, 2006; Lang et al., 2012; Mitchell et al., 2015). However, the stepwise model used in the project and presented in section 6.3, in its very design, provides a framework to help explain and motivate stakeholder engagement into companies' sustainability strategies.

6.2 About the CapSEM project

CapSEM – Capacity building in Sustainability and Environmental Management – is an interuniversity curriculum development and industry training project based in environmental management and sustainability principles. It is co-funded by the Erasmus+ Program of the European Union and was implemented from October 2016 through October 2019. Project objectives surround 1) developing sustainability and environmental management curricula at universities that meet local, regional and international needs; 2) developing and hosting industry training seminars that provide companies with practical methods for improving their sustainability and bridge the gap between academia, industry and wider society; and 3) facilitating cooperation between the consortium, industry partners and their stakeholders. Quantitative indicators of objective achievement outlined at project initiation were, in terms of objective 1, that each university develop, approve, implement and test at least one new master's-level course and assess their other courses and programmes for potential improvement and adaptation according to the stepwise model. In terms of objective 2, each partner country (India, Nepal and Uganda) was to develop and hold at least three industry training seminars,

with evaluation and improvement between each. Indicators for objective 3 included scheduled CB workshops and seminars, project meetings, consortium in-person and online discussion and industry best practice showcases in each country, along with the achievement of indicators associated with objectives 1 and 2. The achievement and/or difficulty associated with these indicators is addressed later in section 6.4.

6.2.1 Project consortium

The project consortium is made up of ten universities, along with supporting industry and stakeholder partners. The EU universities, known as 'programme universities', consist of the Norwegian University of Science and Technology (NTNU), Delft University of Technology (TU Delft) and the University of Lisbon (ULisboa). Each of these partners are heavily based in engineering and work with industry to develop innovative strategies for improved environmental performance and industrial best practice across global value chains, and recognize the importance of stakeholders and industry engagement in sustainable solutions. Expertise and international collaboration across technologic, economic and social disciplines, and with a variety of stakeholders, supports the TD perspective essential to the project. However, it should be mentioned that disciplines directly present in the consortium were mainly engineering disciplines, with economists as the only representatives of the social sciences.

Consortium partners outside of the EU, referred to as 'partner universities', include three universities in Uganda and two universities in each Nepal and India. Based on existing research networks and previous collaboration with the selected partner universities, the consortium was created around the common need for increased sustainability capacity in the selected regions. Strategies for poverty reduction and inclusive and sustainable growth are outlined in Uganda, Nepal and India's national development strategies.

Table 6.1 lists the consortium partners and outlines the interdisciplinary make-up of the project team, with departments and disciplines ranging from business and economics, to climate change, engineering, architecture and health studies. Additionally, the geographic spread of partners brought in a diverse range of cultures and livelihoods. As the project was initiated by the engineering, industrial economics and technology management partners in the EU, it must be noted that partner university disciplines also mainly come from these approaches because of previous scientific collaboration. To increase the level of interdisciplinarity within the consortium, sociologists, geographers and political scientists could have been included as well. Table 6.1 shows that many of the partners' departments are rooted directly in the disciplines that frame the levels of the stepwise model, soon presented in section 6.3, but that not all are based in disciplines that typically undertake the methods suggested by the model. These consortium aspects helped create a diverse project team, but also presented challenges surrounding differences in cultures, values and base-level competencies often recognized in TD projects (McGregor, 2017).

Table 6.1 CapSEM consortium overview

University	*Location*	*Involved department(s)*
Programme universities		
Norwegian University of Science and Technology	Trondheim and Ålesund, Norway	Department of Industrial Economics and Technology Management; Department of International Business
Delft University of Technology	Delft, the Netherlands	Department of Engineering Services and Systems
University of Lisbon	Lisbon, Portugal	Instituto Superior Téchnico, Center for Innovation, Technology and Policy Research
Partner universities		
Makerere University	Kampala, Uganda	Department of Geology and Petroleum Studies; Department of Wildlife and Natural Resources Management; Department of Physics
Makerere University Business School	Kampala, Uganda	Department of Marketing and International Business
Mbarara University of Science and Technology	Mbarara, Uganda	Department of Community Health
Tribhuvan University	Kathmandu, Nepal	Center for Applied Research and Development; Department of Architecture and Planning
Kathmandu University	Dhulikel, Nepal	Department of Environmental Science and Engineering
Indian Institute of Technology Bombay	Mumbai, India	Department of Environmental Science and Engineering, Centre for Environmental Science and Engineering
Tata Institute of Social Sciences	Mumbai, India	School of Habitat Studies, Centre for Climate Change and Sustainability Studies

Through this interregional, -disciplinary and -university network, the partners have collaborated to implement qualitative and quantitative methods for environmental management and sustainability improvement in local organizations, industries and research projects. Recognizing that improving local livelihoods depends on developing infrastructure, reducing resource use and waste and empowering women, among a host of other economic, political and cultural factors, the partners agreed that learning environmental management and sustainability methods and tools could help them assist industries and organizations in their sustainable development.

6.2.2 Project challenges

Before moving to the next section, it is important to mention a few of the challenges associated with the project and its achievement of TD. Many of these are not new and have been presented extensively by scholars (Stokols, 2006; Lang et al., 2012; Mitchell et al., 2015) and in Chapter 3.

6.2.2.1 Funding rules

Funded by the EU, the project was inevitably designed around stipulations of the funding programme. The main objective for this type of project was to build academic capacity for new curriculum development in universities. Although the project designers and resulting consortium recognized the inherent necessity for industry and stakeholder involvement in a project based on improving industrial and organizational sustainability, the funding terms also meant that main deliverables, and therefore time and effort spent, needed to be majorly focused on curriculum development. This posed what Chapter 3 identifies as an 'institutional challenge' (i.e. limitations from current structures, procedures and institutions for knowledge generation). The regulations also mandated that only Higher Education Institutions (HEIs) could receive financial support. In many cases, this left little incentive and few resources for engaging industry and stakeholders. Project objectives of industry training and wider cooperation with stakeholders were still a major part of project design and eventual implementation, but admittedly had to be down-prioritized. This outcome has been a contributing factor to the project's 'small-range TD' classification. However, the authors maintain that although project activities may not have reached the ultimate flexible, open and reflective level of superlative TD research, they did begin the essential linking (Lang et al., 2012) of scientific and academic research with societal needs and stakeholder co-development.

6.2.2.2 Environmental management and sustainability – complex problems

Finally, as widely established by scholars (e.g. Pohl and Hirsch Hadorn, 2007; Vildåsen et al., 2017) and across this book, TD research processes are designed and propitious to address complex and multi-faceted problems facing society,

such as sustainability. The objectives of CapSEM, therefore, merit a TD approach, but also come with the associated challenges of working in a group and towards an outcome with multiple values, actors and ideologies. These difficulties, termed 'inherent challenges' in Chapter 3, result from the very nature of TD processes, and include, among others: different schools of thought, various forms of knowledge, different ways to frame and understand a problem and difficult decision-making and prioritization. As these challenges are addressed in depth in Chapters 2 and 3, they will not be discussed in more detail here, but are evident throughout the remainder of the chapter.

6.2.2.3 Diverse consortium

Multiple aspects associated with the consortium, including its international and interdisciplinary make-up, contributed both to project learning and challenges. A requirement of the funding body, the consortium needed to span world regions and include, at least, three programme universities, i.e. European, and three partner universities from another world region. The more diverse and interregional the project was, the higher the points awarded in the application assessment. Although this is not officially claimed by the EU, discussions since have informally confirmed its validity. CapSEM therefore resulted in an interregional group, spreading across multiple regions, cultures, religions and livelihoods. This diversity brought a richness to discussions and quickly showed a need to adapt much of the European perspectives and expertise to varied infrastructure, value and resource levels. Such therefore required multi-actor reflection, as described in Chapter 3, and also meant that additional time was needed for partners to step out of their comfort zones and adapt to others to overcome these 'teamwork challenges'.

Further, although not mandated by project funders, interdisciplinarity was essential within the consortium to work to influence sustainability and environmental management teaching and implementation in local industry. As a result, this made it difficult for the team to decide on synergistic goals, as the business school academics of marketing and accounting had a very different approach to increasing sustainability principles in the companies they worked with, than those from the multidisciplinary perspectives of academics from a school of livelihood and habitat studies. Plenary discussions at project meetings therefore often reverted to discussions of the philosophy of sustainability and creating a better world, influenced not only by disciplinary differences, but also religion and value-based opinions. As asserted in Vildåsen et al. (2017), this can often lead to confusion around decision-making, and the project team therefore had to agree to move forward with activities and time schedules without defining sustainability goals that satisfied the beliefs of all partners. Because partners were selected based on previous collaboration and of course each had their own agenda for development at their university, it could be argued that there was a level of multidisciplinarity rather than interdisciplinarity to the team, i.e. self-contained work by various disciplines that consider varying perspectives but do not necessarily reach full synergy in the outcomes (Hirsch Hadorn et al., 2008). However, as these aspects

refer to different levels of collaboration (Chapter 2), the authors refer to the team as interdisciplinary because of their commitment to common objectives and increased collaboration between heterogeneous actors.

Although this list is brief and does not elaborate on all specific challenges, it frames some of the factors that maintained the project's small-range TD and contributed to keeping the project between traditional knowledge creation and problem-oriented – i.e. 'mode 2' and TD (Gibbons et al., 1994; Gibbons and Nowotny, 2001) – knowledge creation.

6.3 A stepwise model for sustainability management

To help focus and guide the academic consortium to reach its objectives and achieve sustainability-related impact, CapSEM activities were structured around a model of environmental management and sustainability tools. Companies around the world are increasingly faced with the challenge of how to implement sustainability strategies in their business models. Future business models will need to coordinate technological and social innovations with system-level sustainability. As a wicked and complex problem, sustainable development must be approached from a holistic perspective that can combine the totality of its specialized parts (Lang et al., 2012; Brandt et al., 2013; Schaltegger et al., 2013).

A toolbox for the systematic implementation of sustainability knowledge is therefore organized in a stepwise progression through four levels: 1) process; 2) product/value chain; 3) organizational; and 4) systemic (see Figure 6.1). Similar

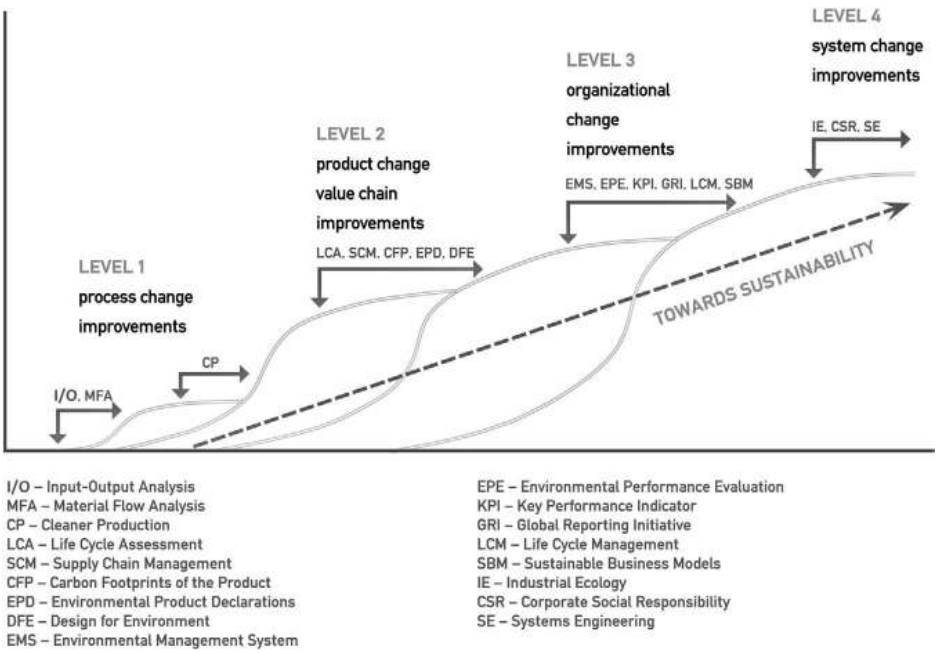


Figure 6.1 A stepwise model of tools and methods towards sustainability

classifications have been performed by other scholars (e.g. Robèrt et al., 2002; Singh et al., 2012), and different typologies can be argued. The stepwise model in Figure 6.1 has been developed by researchers at NTNU over many years to effectively communicate and demonstrate the need for companies and stakeholders to look beyond a lower level, i.e. Level 1 and/or 2, to build more holistic sustainability management (Fet, 2002).

The tools referred to in this model span both quantitative and qualitative methods; from material flow analysis (MFA) and life cycle assessment (LCA), to corporate social responsibility (CSR) strategies, industrial ecology (IE) and systems engineering (SE) principles. For the majority of the tools and methods, the focus is on monitoring environmental aspects, especially in Levels 1 and 2. As one moves towards Level 3, and especially 4, more complete sustainability aspects are considered – mandating the inclusion of social aspects. It is important to see the model as a transitionary process where environmental management strategies become more holistic and complete towards triple-bottom-line sustainability as tools at each level build upon each other.

The waves between levels demonstrate how the methods build upon each other. Each wave increases the number of environmental and social aspects managed and stakeholder needs incorporated into a firm's strategy. As a firm moves from one wave to the next, they advance towards a higher level of sustainability maturity and a broader inclusion of stakeholders. Many of the methods presented are valuable for the study of complex cases in which knowledge integration is necessary, e.g. cases of TD research. For example, Scholz and Tietje (2012) present MFA, LCA and systems dynamics as methods that can link knowledge from varying disciplines, systems perspectives and modes of thought.

Level 1 tools target production *processes* and identify potential improvements through input–output analyses (I/O) and material flow analyses (MFA), in which objectives are set related to environmental aspects of resource use, energy, water consumption, emissions and waste generation. On this level, efforts are usually driven by economic incentives since better environmental resource efficiency can equate to economic gain. Resource efficiency is also the core of cleaner production (CP) principles where source reduction, 'getting more from less', is the focus rather than end-of-pipe solutions.

Level 2 tools focus on sustainability improvement for *products and their value chains*. The most recognized tool for mapping the potential improvements of a product's environmental footprint is life cycle assessment (LCA). This tool quantifies material flows across the entire life cycle of the product, from 'cradle to grave'. The results from the analyses are classified into several environmental impact categories such as global warming potential, acidification potential and eutrophication potential. Based upon a set of weighted criteria, the results can be applied within supply chain management (SCM) to set requirements upstream in the supply chain. Examples could be to replace material with a high impact factor to one with less environmental impact, or to change transport means that contribute to high greenhouse gas emissions. Results from an LCA can further be used to document the footprint of the product across all environmental criteria, e.g. through environmental product declarations (EPD), or

on selected criteria, e.g. quantified carbon footprints of the product (CFP). By applying principles of design for the environment (DFE), great achievements can be made, also for the end of life treatment of the products where material can be separated into their recycling loops (design for dismantling-principle). Similar to Level 1, quantitative information contributes to an understanding of how to shift to more sustainable material and design of products. Cleaner production principles can also be applied on the product level as well as the organizational level, Level 3.

Level 3 tools are concerned with an *organization's management* of its sustainability challenges through, for example, the implementation of an environmental management system (EMS). An EMS is often designed in accordance with ISO 14001 for certification. Small and medium sized companies are often recommended to use their health, safety and environment (HSE) system as the first approach to EMS implementation. Other companies may only want to set up an environmental account of aspects and impacts for the purpose of internal benchmarking and for an inhouse environmental performance evaluation (EPE), using key performance indicators (KPI) for reporting purposes. For larger corporations, the global reporting initiative (GRI) is often used to evaluate performance against international branch standards. A wider focus through life cycle management (LCM) is another approach to an organization's sustainability management and can help a firm translate its business model into one with sustainability as a core value – a sustainable business model (SBM). It is within this level that the consideration of social aspects, e.g. labour issues, HSE systems, societal impact, may begin. Through these mechanisms, a company will become aware of their environmental and sustainability performance and will learn how to monitor and present it according to international standards and systems.

The highest level in the model, Level 4, represents tools that facilitate a *systemic* focus. It should again be noted that Levels 1–3 deal mainly with the environmental aspects of a production process, product, value chain or organization. However, through the process of e.g. identifying and implementing more environmentally efficient technologies, the economic and social aspects of sustainability have to be addressed and weighted to find the best solution for the company and its stakeholders. In Levels 3 and 4, the methods define the system boundary outside of a specific company or organization and incorporate stakeholders, policy makers, industry representatives and academia more extensively. Corporate social responsibility (CSR) embraces the triple bottom line of sustainability and is one approach to stakeholder engagement. Additionally, principles of industrial ecology (IE) and systems engineering (SE) provide methods for the holistic and embedded study of sustainability management.

The four-level model can be regarded as the backbone of many roadmaps and standards for strategic and systemic innovation and implementation, and as a foundation for business decisions at different systems levels. It provides a way to integrate knowledge across the breadth of sustainability management tools and compile them into a coherent framework for use in academia and by practitioners.

Table 6.2 summarizes the disciplines addressed throughout the CapSEM project and the implementation of the model. For example, to achieve process

Table 6.2 Overview of the methods and main disciplines at each level of the stepwise model

Level	*Scope of level action*	*Recommended methods*	*Main disciplines*
Level 4	Systemic improvements	Industrial ecology principles, networks, industrial symbiosis, systems engineering, circular economy	Engineering, social sciences, political science, economics
Level 3	Organizational improvements	Environmental management system, sustainability communication and reporting (GRI and SDGs), environmental performance evaluation, key performance indicators, sustainable business models, corporate social responsibility	Technology management, economics, management, social sciences
Level 2	Product- and value chain improvements	Life cycle assessment, supply chain management, carbon- and water-foot printing, environmental product declaration, design for environment	Engineering, natural sciences, industrial ecology, technology management, economics
Level 1	Process improvements	Block diagrams, pollution prevention strategies, cleaner production, material flow analysis, energy analysis	Engineering, industrial ecology, natural sciences, economics

improvements at Level 1, a few methods are recommended to map and measure areas where resource or material efficiency can be improved. These methods are rooted in competence from the disciplines of engineering, industrial ecology and the natural sciences. To solve complex problems, it is important to use methods that integrate multiple disciplines and use quantitative and qualitative data to calculate the holistic picture (Scholz and Tietje, 2012; see also section 2.3). The table demonstrates the recommended methods (the principles and tools to understand which improvements should be made to move towards more sustainable solutions) and the related disciplines for the other three levels. Coupling the multidisciplinary tools and methods with the model's specific design can assist companies in reaching holistic sustainability management that extensively incorporates its stakeholders – making it a transdisciplinary model.

Now that the CapSEM consortium and objectives and the stepwise model have been introduced, the next sections discuss the project activities and methods (section 6.4) and the model (section 6.5) specifically in relation to TD.

6.4 Project activities and methods

Project methods and activities have surrounded a combination of stock taking, material sharing, industry visits, workshops, seminars and direct teaching and training. This allowed for mutual learning between partners along the stepwise model. The model presented in Table 3.1 in Chapter 3 and below in Figure 6.2 by Jahn et al. (2012) can be used to demonstrate the systems thinking approach applied in the design and implementation of the CapSEM project. This model proposes three phases of an ideal TD research process. In phase 1, *Formation of a common research object*, societal and scientific problems are linked and transformed into a shared problem. Next, in phase 2, *Production of new knowledge*, knowledge relating to the problem is combined and integrated across disciplines. When a project reaches phase 3, *Transdisciplinary integration*, the knowledge integrated in phase 2 is evaluated for its application and value in both societal and scientific praxis. Jahn et al. (2012) highlight the non-linearity and iterative nature of their model and emphasize that the steps of their process are likely to receive unequal weight depending on the nature of the research project.

This approach can also be aligned with the systems engineering (SE) framework (Fet, 1997) according to the six-step methodology: 1) identify needs; 2) define requirements; 3) specify performance; 4) analyse and optimize; 5) design, solve and improve; and 6) verify and test. Phase 1 in Jahn et al. (2012) corresponds to 1) and 2), phase 2 with 3), 4) and the first part of 5), and phase 3 corresponds to 5) and 6).

Table 6.3 presents the seven activity phases of the CapSEM project generally aligned with Jahn et al.'s model. Project activities 1–3 can be related to TD phase 1. These activities also ascribe to the TD aspects of problem identification and structuring and problem analysis asserted in Pohl and Hirsch Hadorn (2007). First is the development of the *project idea and application*, which used the stepwise model as a guiding and common framework for activities and objectives. Notedly, the problem formation at this stage was informed majorly by the funding agency and their expectations for awarding support, i.e. building academic capacity and curricula at partner universities. As mentioned, the involvement of stakeholders and industry partners was not an explicit requirement set by the funders, although it was highly valued and an essential part of any sustainability management project. Their stipulations, however, directed the project from the beginning to less of an open research process which, among other factors, may have contributed to the small-range TD of the project (Mitchell et al., 2015; Chapter 2).

Next, activity 2 focused on *establishing clear baselines*. Programme partners gathered teaching material developed at their home institutions during previous research projects with industry and public bodies. From NTNU, for example, experience from the Fiskerstrand Shipyard case (presented in section 6.6.1) was added to the CapSEM material. In parallel, partner universities performed *gap analyses* of existing curricula and identified areas along the stepwise model in which they wanted to focus and further develop their capacity. Throughout the project period, the identification of stakeholder needs became more explicit and

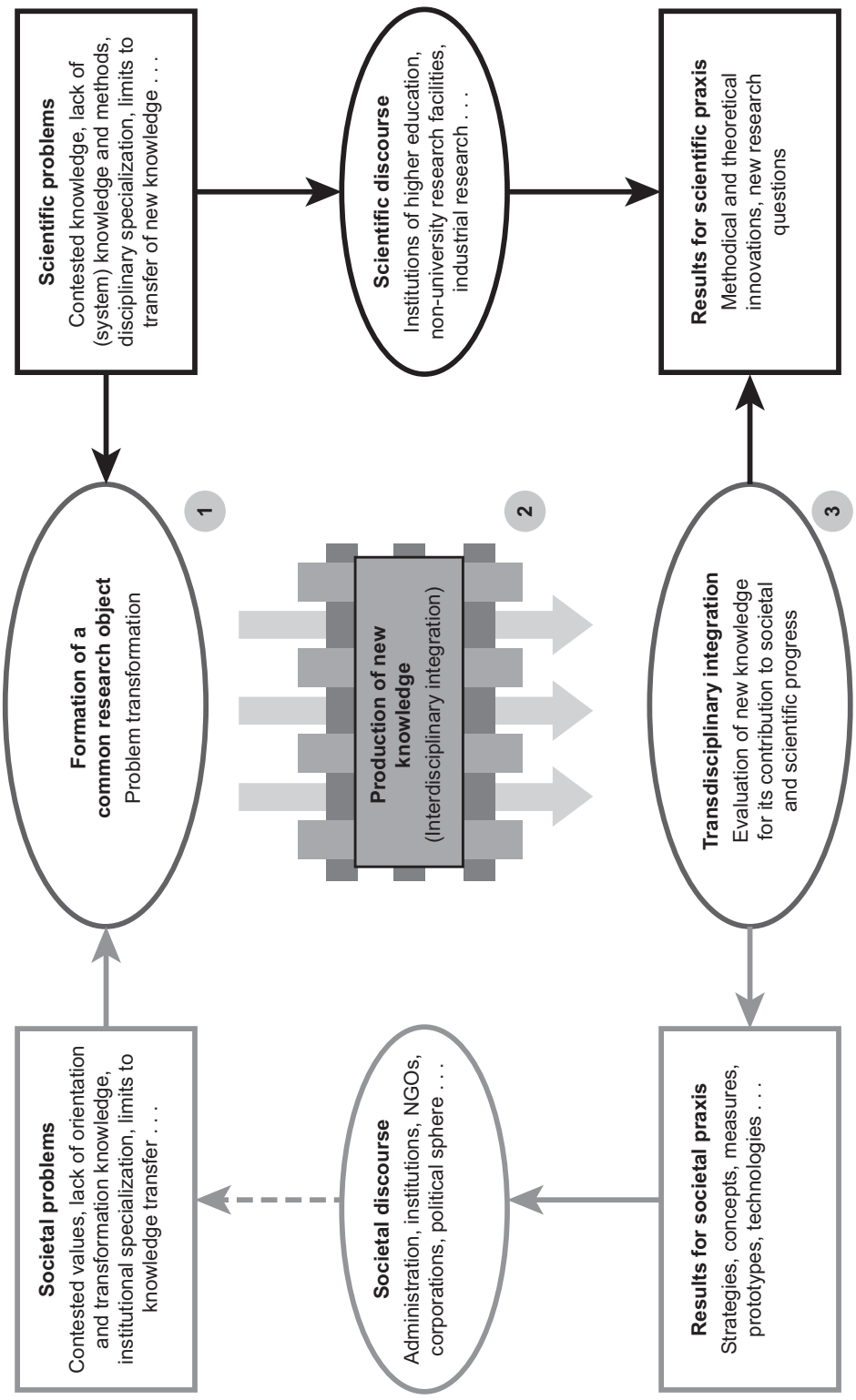


Figure 6.2 A conceptual model of the 'ideal' TD research process

Source: Redrawn from Jahn et al. (2012, p. 5)

Table 6.3 CapSEM project activity phases in relation to the ideal TD process

TD phase 1: Joint problem framing activities			
1) Project development	a) Problem formulation b) Selection of stepwise model and project design		
2) Establishing baselines	c) Available material at programme universities d) Gap analysis of partner university curricula		
3) Material packages	a) Material combination into modular packages b) Package updating throughout project		
TD phase 2: Production of new knowledge			
Societal		*Scientific*	
6) Industry and stakeholder training	a) Partner university professors and researchers design and hold training within or across the stepwise model b) Evaluate and improve upon trainings c) Best practice showcases for project partners	4) Capacity building at partner universities	5) New or adapted curriculum development
		a) Collaborative seminars with programme and partner university professors and researchers b) Internal workshops at partner universities c) Identification of focus areas, depending on existing curricula and local needs d) Partner exchanges	a) Course design b) Administrative approval c) Course testing d) Course offering
TD phase 3: Transdisciplinary integration			
7) Online course development	a) Updating material packages and transforming into video lectures b) Designing open online course with video lectures and MPs c) Testing course among project partners d) Offering online course		

Source: Authors' alignment with Jahn et al. (2012)

was pinpointed more directly by some partners. Such supports the reiterative and unequally weighted aspects of Jahn et al.'s (2012) model and highlights both the challenges and need for TD collaboration in the context of sustainable development. It was in this initial baseline activity that the span of partner perspectives and needs began to grow beyond those expected when developing in the project, and individual objectives of each university became apparent. These included the need for a wide range of input materials, from the very basic, to extremely technical, and the expectation from some partners to receive all material and teaching directly from the European universities without much engagement, and that of others to work cooperatively to share knowledge.

In activity 3, the gaps and resulting focus areas were then incorporated into a reiteration of the *material packages*, which included training material on each of the four levels for further development and knowledge sharing. Within project activity phases 1–3, the project boundary was defined by gathering perspective on expected project impact and the types of materials and training that might result (Mitchell et al., 2015).

Moving to phase 2 of the TD model and the production of new knowledge, project activities 4–5 can be discussed. After clarifying project boundaries in the previous phase, the next steps required that different perspectives and needs could be accommodated with a common understanding (McGregor, 2017). Here the stepwise model is essential, as it helped to frame the views of various partner disciplines around a common research object. Using the material packages and input from national partner teams in India, Nepal and Uganda, the *capacity building* activity began (activity 4) with CB seminars developed around the material packages and adapted for and held in each partner country. The application of the stepwise model as a shared framework gave all partners a common discourse for the future creation of curricula and other projects aimed at local industry and regional environmental management initiatives (ibid.). Indicators for achievement of this activity included the national-level CB training seminars and industry best practice showcases each held in Nepal, India and Uganda where consortium partners began their discussions and training in CapSEM methods and tools. Activity 4 CB continued through the duration of the project period and the achievement of all remaining deliverables and indicators.

As the CB phase continued, each partner university identified a focus for activity 5 of *course development or improvement*. Decided during project development, each partner university was to be responsible for developing at least one new master's course related to the knowledge embedded in the stepwise model and project CB. During the activity, however, the consortium quickly realized that it would be impossible to achieve this indicator across all partner universities, not only due to time constraints and bureaucratic difficulties, but also because of the varying needs at each, where some felt an earlier bachelor's-level course should be prioritized, or that improving existing master's-level courses would bring more value. Courses therefore became based on the greatest perceived need at each partner, determined through the gap analysis and CB phase, and consistent with regional and national priorities. This resulted in the development and testing of at

least one new or heavily adapted course at each partner. Upon project completion, this totalled two new and one improved bachelor's-level courses and three new and 16 improved master's-level courses. Although it could be argued that the curriculum development phase is only university–university collaboration, TD was present in the involvement of industry actors and stakeholders in the design and offering of many of the courses. Company and stakeholder engagement and the relevance and implementation of methods for local industry were inherent to the design of each of the courses and to the stepwise model around which they were built. For example, one of the newly improved courses in India has incorporated a case-based project where students are required to undertake a small development project on their campus. This requires collaboration and discourse with professors, PhD students, university bodies and local industry for implementation.

At this point, activities split and reiterated into parallel tasks of continued capacity building and further course development (scientific) and industry training development (societal). This also represents the transition to TD phase 3, transdisciplinary integration, and the beginning of some of the first iterations of the left and right feedback loops essential in Jahn et al.'s (2012) model (refer back to Figure 6.2). Knowledge exchanged in earlier phases helped partner universities identify important local companies and stakeholders, presented in Table 6.4. To improve the quality of sustainability and environmental management curricula, and its relevance to the labour market and local society, partners then collaborated with their identified companies and stakeholders. *Industry training seminars* (activity 6) were developed and held to facilitate cooperation between partner universities and local industries for practical and case-based learning. In Nepal, India and Uganda, a minimum of three training seminars each were given directly to industry and organization partners, along with a best practice industry showcase in each of the six consortium countries.

Finally, the capacity built through these activities has contributed to the development of a video lecture series and material for use by partners and applied in an *open online course* (activity 7). The video lectures were designed in a modular format along the stepwise levels for use and application as needed. The final video modules and related material are openly available on the project website (https://capsem.wordpress.com/learning-material) for use for baseline capacity building, teaching and training, and were designed to be accessible for both academic and non-academic audiences. They have further been incorporated into an open online course (https://onlinecourses.tudelft.nl/courses/course-v1:TUDelft+CAPSEM01+2019/course/). The online course and video modules represent a common project result that is valuable for its TD synthesis and comprehensiveness (McGregor, 2017), and are used for engagement in both scientific settings, i.e. with professors and students, and societal settings, i.e. with companies, governmental and non-governmental bodies and other stakeholders.

Referring again to the 'ideal' TD process model (Jahn et al., 2012), the concept of both the left and right feedback loops is especially important. It is within the initial rounds of these reiterating loops that the project remains currently. Most weight has been placed on the right academic loop, but the *lifeworld approach* of

Table 6.4 Industry sectors, NGOs and public organizations in case-examples

Industry sectors and organizations	*Location*	*Partner university(ies)*
Partner countries		
Cement 1	Kampala, Uganda	Makerere University
Agriculture 1 (Oil palm)		
Agriculture 2 (Tea)	Kampala, Uganda	Makerere University Business School
Agriculture 3 (Sugarcane)		
Wildlife education	Mbarara, Uganda	Mbarara University of Science and Technology
Local government environment officers		
National Planning Authority		
Renewable energy 1	Kathmandu, Nepal	Tribhuvan University
Renewable energy 2		
Medicinal plants	Dhulikel, Nepal	Kathmandu University
Cement 2		
Telecom		
Women's foundation for wastewater management	Mumbai, India	Indian Institute of Technology Bombay
Municipal Council		
Environmental consultancy	Mumbai, India	Tata Institute of Social Sciences
Environmental technology 1		
Environmental technology 2		
Plastic recycling association		
Programme countries		
Cement 3	Trondheim and Ålesund, Norway	Norwegian University of Science and Technology
Waste management and recycling		
Maritime		
Energy	Delft, the Netherlands	Delft University of Technology
Port management		
Cement 4	Lisbon, Portugal	University of Lisbon
Environmental management consultancy		

the left loop has also cycled to help better inform scientific partners of the societal problems and discourses in project contexts. While the project maintains a smaller scale application of TD, the next section elaborates on the stepwise model and the broader and more holistic TD for sustainability management that results from it.

6.5 Transdisciplinarity and the CapSEM model

While section 6.4 discussed specific aspects of TD in the CapSEM project process, this section discusses the TD embedded in the stepwise model (Figure 6.1) and the ways in which it encourages and requires engagement from a range of actors. By structuring environmental management and sustainability methods and concepts within the four-level model, the potentially daunting expanse of methods and theories are taught in a manageable and logical way for practical application and knowledge transfer. A common knowledge integration model builds consensus on

the way forward. In the project, this consensus has been sustained in the level-based modules of learning material. By building a base level of sustainability and environmental management capacity, the application of new knowledge in both academic and industrial settings could begin to help break down barriers between academic and industrial actors in local communities.

For example, during the final project meeting, one representative from a university in Uganda expressed his initial hesitation in joining the project because of lacking formal ties with industry. The use of the standard model, however, helped him to recognize that the existing engagement with local agricultural stakeholders was already quite strong through course involvement and student projects. The project methods were only first daunting because they presented different terminology and were more technically complex than what existed at the university. Using the model as a framework for learning helped the team apply the general principles it teaches to their own context and realize the work they were already conducting towards more holistic sustainability in their community. The next sections describe the TD value of the stepwise model in more detail, first by outlining the disciplines within which it is rooted and can be applicable for, and next through the presentation of industrial case studies from CapSEM partners in which it was used.

6.5.1 Stakeholders addressed across the stepwise model

As shown in Table 6.2 and affirmed by the literature (e.g. Brandt et al., 2013; Schaltegger et al., 2013; Popa et al., 2015), knowledge rooted in many disciplines is a must to achieve improvements that lead towards more sustainable practices. Different stakeholders with the actual competence needed for the transition will often be involved through actors in the supply chain, through consultancy work or through training and capacity building. Thus, the model has greatly strengthened the focus on how to implement solutions for improvements in industries in project countries. NTNU, TU Delft and IST have a long tradition of working with companies, and the transfer of these experiences has been a focused effort throughout the three-year project period.

The span of disciplines included in the model (Table 6.2) and across the consortium (Tables 6.1 and 6.4) contributes to a holistic systems perspective that considers environmental, social and economic aspects of sustainability. As discussed in section 6.3, the CapSEM stepwise model does however place its main focus on the environmental pillar of sustainability. As the stepwise model moves towards greater sustainability, it is in Level 4, and the higher degrees of Level 3, that the incorporation of stakeholders, and social sustainability, is most extensive. Stakeholder involvement in the lower levels is still important for the implementation of the recommended tools and methods, e.g. consideration of consumer needs and existing recycling practices in design for environment. Although it may be more selective at these levels, and based mainly on the organization making improvements for themselves, rather than the greater good, stakeholder involvement is vital and required for companies to make sustainability improvements at all levels.

At Level 1, for example, to make improvements in waste treatment processes, TD engagement must take place between engineers, economists, communities/municipalities and other policy makers. In addition, consumer or employee pressure could be what influences a company to undertake better waste management strategies in the first place. Stakeholder engagement takes place in many parts of a value chain. Level 2 improvements therefore rely on knowledge from various actors on the materials of a product, associated costs, maintenance practices, transportation and marketing, to name a few. Level 3 requires communication with stakeholders to best define management plans for improved sustainability. For example, in establishing strategy benchmarks, a company will need to select environmental and social performance indicators in collaboration with stakeholders in order to measure their progress. In this case, they may be employees, consumers, local community members, marketing firms and company management. At Level 4, stakeholders are extensively involved and their input provides necessary input to all tools at this level. To better illustrate the TD processes at work in the stepwise model, case studies of its use by CapSEM partners are presented in the next section.

6.6 Industrial case studies

Along with the capacity building activities at partner universities, industry training and engagement was an important part of the project for all partners. Although not explicitly designed as a TD project, an essential part of CapSEM has been to develop training seminars for the dissemination of sustainability management methods into practice. Strengthening and utilizing partners' existing experience working with private and public sector actors, training seminars were designed to effectively reach practitioners and policy makers through practical and easy-to-follow guidelines that took into account local contexts. Using the stepwise model as a baseline, relationships between universities, companies and local policy makers could be initiated or grown. Industry impact is an essential component of CapSEM success since the reduction of a nation's level of poverty and environmental degradation is dependent on a transformation in local industry through socially and environmentally sound practices and technologies. The four-level CapSEM model is designed to help show companies how they can improve their processes, products and organizations, and further how they can contribute to a systemic change of mindsets in society, illustrated with the fourth level.

Table 6.4 gives an overview of the industry sectors and adjacent organizations that have been involved through the project period. It should be noted that many of the sector companies, NGOs and public organizations were already partnered with the university(ies) before the project began. The cases are varied across public and private actors, and industry sectors, from agriculture, wildlife and resource management, to cement, environmental technology and renewable energy. Examples from the project partners' application and use of the stepwise model follow in the next section.

6.6.1 Programme country case

Industry sectors in the programme countries have contributed with experiences from each of the levels in the CapSEM model.

6.6.1.1 Case-example from Norway

One example is from the maritime sector in Norway where Fiskerstrand Shipyard has moved along all levels in the model over a period of 25 years. Table 6.5 shows how they have engaged with each of the levels to build their comprehensive understanding of sustainability management for their operations and stakeholders. The process demonstrates the need for reiterations between researchers and company actors over a long period of time to produce an integrated result.

Table 6.5 Application of the stepwise model to improve sustainability management at Fiskerstrand Shipyard

Year	*Action*
1992	Intensified work on HSE (Level 3)
1993–94	Built capacity through a cleaner production project on how to reduce costs and materials connected to the processes of bottom hull cleaning, outdoor painting, waste disposal after rebuilding a ferry, waste treatment of blasting sand from cleaning of painted steel (Level 1, Level 2 and Level 3)
1994	Established baseline for environmental management system, hereunder environmental strategy, environmental accounting, setting goals and plans for environmental performance improvement programmes (Level 3)
1995–96	Implemented methods for environmental performance assessments for increased waste minimization in the ship building industry (Level 1)
1997–98	Updated HSE manual, in addition to performing risk analyses and revising procedures in their external safety manual (Level 3)
1999	Started work on an environmental management certification, developed industry specific environmental requirements and published their first environmental report. Received the certificate for good environmental 'housekeeping' practices for repair and new building yards (Level 3 and Level 4)
2004–07	Updated HSE manual and incorporated it as part of the quality assurance manual in accordance with the requirements of ISO 14001 standard for environmental management (Level 3)
2007 – today	Have maintained and improved their approach to an annual environmental accounting system, using key performance indicators, produce an annual report on environmental aspects and impacts and contribute to systemic regional improvements (Level 1, 3 and 4)

Source: Fet (2018)

6.6.2 Partner country cases

The focus in the case-examples from India, Uganda and Nepal was mainly on Level 1 (cleaner production) and Level 3 (environmental management) of engineering, agriculture and natural resource management, and reflected the industries that currently support regional and national development needs. Case-based work has made the biggest impact and brings necessary sustainability management strategies to areas in need of capacity to better local livelihoods. In a larger context, case-examples related to Level 4 (industrial symbiosis and circular economy) have as a result seen the necessity of working with regional governmental bodies and municipalities. Although partners took different approaches, some with open trainings for multiple companies, and others with more focused seminars for specific stakeholder groups or local organizations, all applied the stepwise model of tools as appropriate. Each partner university held at least three training seminars with evaluation and improvement between each. Strengthened industry partnerships helps translate the sustainability knowledge into practical application and inform researchers about the needs of their industry partners and their stakeholders.

As asserted in Chapter 3 of this book and by Lang, et al. (2012), the objective of TD research is to use the combination of cycles of both empirical academic research and practical solutions for societal problems to develop consequential outcomes for society. Making the link between the two cycles is the essential step to create useful solutions. The case-examples below therefore demonstrate the beginning initiatives of combining cycles of academic research and practitioner knowledge away from 'mode 1' research. Although this combination has not yet led to the creation of completely new knowledge, in most cases, knowledge sharing and building have begun to cohesively frame societal problems that the two groups can begin to attempt to solve.

6.6.2.1 Case-example from Nepal

In Nepal, partners focused on industries that are growing to fulfil the country's demands in food, infrastructure, energy and consumer goods. Throughout the project, industry partners were based in renewable energy technologies, such as wind, solar and biogas, for use in both rural and urban settings. In response to the 2015 earthquake, expanding urbanization and the need to improve infrastructure and livelihoods in rural and city areas, infrastructural partners – such as telecom to improve communication technologies and cement factories for construction and rebuilding purposes – also engaged with professors and PhD and master's students from the Institute of Engineering at Tribhuvan University and the Department of Environmental Science and Engineering at Kathmandu University. An official from the Government of Nepal's Alternative Energy Promotion Centre (AEPC) participated in a full-day industry training session on MFA (Level 1), LCA (Level 2) and EMS (Level 3). He participated in discussions with researchers and companies about the tools and their grounding in the essential long-term and holistic perspective for environmental sustainability that must accompany national policies

and economic development. Nepalese industry partners also gained insight into the possibilities for expanding their thinking to the entire product life cycle by learning from advanced and proven sustainable techniques applied in the programme and partner countries. Although at this point, knowledge is flowing more from university actors to practitioners and not as a full co-production process, applying the stepwise model in CapSEM meetings and workshops has contributed to the initiation of more synergistic collaboration between the universities, partner industries and policy makers for implementing environmental and societal management tools.

6.6.2.2 Case-example from Uganda

In Uganda, priority areas for national development include energy access, infrastructure development, and access to services such as waste management. Petroleum is another important aspect for sound environmental management, to avoid large environmental disasters or the displacement of local people. Agriculture management in line with sustainability, including tea processing plants, oil palm growers and sugar producers, are another main focus. Additionally, resource provision to large refugee camps must be improved. In a full-day industry session hosted by the three Ugandan partner universities, the waste management strategies of other project countries were discussed with representatives from the National Planning Authority, National Environmental Management Authority and the director of a waste management initiative to attempt to implement systems level thinking into future management plans. In addition, collaboration between programme and partner universities and with industry practitioners led to an in-depth analysis of a local cement factory and quarry. Applying LCA approaches (Level 2) learned at NTNU, Makerere University professors and researchers spent time collecting impact data from the company related to resource consumption, emissions and waste. Working with the plant manager, its geologists, electrical and mechanical engineers, environmental officer, quality control manager and production manager, the Makerere team identified operational, institutional and organizational gaps, and has performed the first two steps of an LCA. The remaining steps are expected to be completed within 2021. This analysis has already exposed areas to improve resource efficiency, reduce pollution and improve safety in the factory and quarry, and would not have been possible without the dynamic team and reflexive approach.

6.6.2.3 Case-example from India

In India, the team at IITB has conducted a demonstration project for the circular reuse of wastewater in the rural town of Mhaswad in the State of Maharashtra. Recognizing the importance of and correlation between the reduction of hunger and poverty and the empowerment of women, the team has supported the intervention of sustainable wastewater treatment technology while insisting on the participation of the members of the community in shaping the policy response for transitioning to

sustainable futures. The introduction of constructed wetland beds is therefore aimed at empowering a group of women through the production of recycled water. The beds make up a municipal wastewater treatment plant that is capable of treating 250 m^3/day of raw municipal wastewater generated by approximately 40% of the population of Mhaswad. With the conception, design, support and monitoring from IITB, the plant was constructed with an NGO in collaboration with the Municipal Council. Mhaswad and the surrounding area have faced severe droughts and low rainfall over the past five years. The treated water has therefore been very much welcomed and is utilized in the adjoining community garden, for construction activities and, most importantly, in the fodder camp that has saved more than 3000 cattle by providing fodder, shelter and treated water. The case has demonstrated the benefits of adopting a circular economy approach (Level 4) while addressing the need of water in a community and its concurrent socio-economic benefits. In addition, the Municipal Corporation of Greater Mumbai announced that the technology of constructed wetland developed by the group at IITB would be implemented at a larger scale for treatment and reuse of wastewater in the municipality. This was prompted through engagement with the IITB researchers, circular economy concepts and a visit to their pilot-scale research station during the CapSEM project.

6.7 The stepwise model and the SDGs

These case examples, along with numerous others, demonstrate how transdisciplinarity facilitated through the tools and objectives of the stepwise model can support the design and uptake of sustainable approaches for local, regional and global sustainable development.

Furthermore, for system-level initiatives like the SDGs to shift the global system onto a sustainable path, there is an increased need for transdisciplinary thinking and action. Figure 6.3 therefore illustrates how the SDGs can be placed along the same stepwise model to communicate the framework's objective easily to companies. The figure was developed during the CapSEM project period to meet

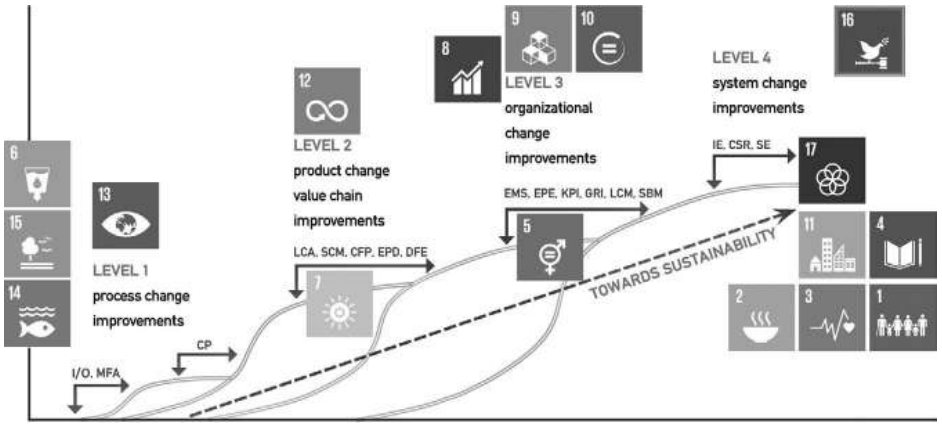


Figure 6.3 Example of connecting the stepwise model to the SDGs

a growing number of questions from the partners about how to encourage industry partners to see the holistic picture of the model and the SDGs, and communicate progress towards the goals. Recognizing the systemic foundation of the framework, it must be noted that even though the goals are placed to illustrate areas of improvement at a specific level, they also fit into each of the other levels. Additionally, because the UN's formal indicators are written for national governments, industry-specific indicators must also be selected for firm-level measurement. By placing each of the goals on a level, however, companies are able to easily begin to apply systemic thinking to their work towards the SDGs by using the goal at the specific level as a starting point. As described earlier in this chapter, material flows connected to production processes (Level 1) generate impacts on the natural environment, here indicated with SDGs 6, 13, 14 and 15. At Levels 2 and 3, SDGs 8, 9, 10 and 12 are connected to circular economy, innovation, equity and sustainable economic growth, all with economic implications. The other nine SDGs are all connected to societal development, and the impact of e.g. access to clean energy (SDG 7), competence and education (SDG 4) and good health (SDG 3) as shown in the figure.

The SDGs as a framework help contribute to coherent framing of sustainability problems, one challenge of TD asserted in Brandt et al. (2013). Although Figure 6.3 is in its early state, the authors believe that its simplicity can help communicate with industry actors to make the overwhelming 17-goal framework become more manageable. The figure may not represent new knowledge in itself, but it serves as a way to jointly frame problems for effective communication between actors for future TD research.

6.8 Concluding remarks

The chapter has reflected upon how TD has been achieved along two main tracks, namely through the interuniversity CapSEM project and the stepwise model. The project's activities followed a TD process to integrate sustainability principles along a network of professors, researchers, students, industry and stakeholders. This collaboration helped to build ability to practically address local sustainability challenges. Using the structured model as a baseline and taking stock of existing capacities, strengths and gaps allowed the consortium to work together to develop and implement environmental management principles that meet local, regional and international needs and contribute to a more holistic understanding of sustainability. CapSEM's systemized, transdisciplinary and practical approach has helped share international best practices and benefits of sustainable transition strategies for companies and governments. Project activities facilitated the cooperation of academics from multiple disciplines for the development of material for academic and practical use. Other organizational representatives also contributed to model implementation. Industry–academia partnerships that developed through project activities helped to break down existing barriers and make the practical application of sustainability methods an accessible part of local business capacity.

Even with this beneficial cooperation and achievement of common goals, challenges related to the TD process were also present in the project. These included the messy and complex problem of sustainability (an inherent challenge); dictated guidelines from the funders regarding expenditure; limited opportunity for flexibility from the original project plan and a set time limit for achievement (institutional challenges); and differing cultural, value and disciplinary opinions (teamwork challenges). Although the project's approach to TD may be considered small-range, the TD of the stepwise model presented the important perspective of systems thinking to solve complex problems.

To achieve more extensive TD within the project, stakeholder collaboration could be more explicitly undertaken to achieve mutual learning and impact (Mitchell et al., 2015) through all project activities, and to continue beyond the project lifetime. The progressive stepwise model, however, mandates the involvement and inclusion of stakeholders in its very design. Although the comprehensive involvement of stakeholders takes place mainly at the higher levels, the lower level tools and methods still require companies to move beyond limited firm-only thinking. The stepwise CapSEM model can therefore be further utilized as an approach for TD collaboration across the various system levels. The authors argue that experiences from the CapSEM project and use of the stepwise model are a powerful baseline for reflection upon the implementation and development of environmental management and sustainability knowledge in varying global contexts. They have also created a family of academic researchers that, despite disciplinary and personal distinctions, have supported each other's knowledge creation and application for livelihood and sustainability improvement. Future projects will categorically include a more extensive range of stakeholder collaboration, and, ideally, find funding with more flexibility for adaptation based on knowledge created and a longer time period to get there.

References

Brandt, P. et al. (2013) 'A review of transdisciplinary research in sustainability science', *Ecological Economics*, 92, pp. 1–15. doi: 10.1016/j.ecolecon.2013.04.008.

Fet, A. M. (1997) 'Systems engineering and environmental life cycle performance within ship industry', Doctoral Thesis, The Norwegian University of Science and Technology, Trondheim, Norway.

Fet, A. M. (2002) 'Environmental management tools and their application: A review with references to case studies', in Conceição, P. et al. (eds.), *Knowledge for Inclusive Development: International Series on Technology Policy and Innovation*. Santa Barbara, CA: Greenwood Publishing Group, pp. 449–464.

Fet, A. M. (2018, October 24) *Environmental management at Fiskerstrand Shipyard: A 25 year journey*. CapSEM Meeting Presentation, Ålesund, Norway.

Gibbons, M. and Nowotny, H. (2001) 'The potential of transdisciplinarity', in *Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society*. Basel: T. Birkhauser.

Gibbons, M. et al. (1994) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

Hirsch Hadorn, G. et al. (2008) 'Handbook of transdisciplinary research', in *Handbook of Transdisciplinary Research*. Dordrecht, Netherlands: Springer, p. 506. Available at: http://link.springer.com/10.1007/978-1-4020-6699-3_5.

Jahn, T., Bergmann, M. and Keil, F. (2012) 'Transdisciplinarity: Between mainstreaming and marginalization', *Ecological Economics*, 79, pp. 1–10. doi: 10.1016/j.ecolecon.2012.04.017.

Lang, D. J. et al. (2012) 'Transdisciplinary research in sustainability science: Practice, principles, and challenges', *Sustainability Science*. Springer Japan, 7(S1), pp. 25–43. doi: 10.1007/s11625-011-0149-x.

McGregor, S. L. T. (2017, April–June) 'Challenges of transdisciplinary collaboration: A conceptual literature review', *Integral Leadership Review* (Feature Articles). Available at: http://integralleadershipreview.com/15402-challenges-of-transdisciplinary-collaboration-a-conceptual-literature-review/ (Accessed 27 August, 2019).

Mitchell, C., Cordell, D. and Fam, D. (2015) 'Beginning at the end: The outcome spaces framework to guide purposive transdisciplinary research', *Futures*. doi: 10.1016/j.futures.2014.10.007.

Pohl, C. and Hirsch Hadorn, G. (2007) *Principles for Designing Transdisciplinary Research: Proposed by the Swiss Academies of Arts and Sciences*. Munich, Germany: Oekom Verlag. Available at: http://www.transdisciplinarity.ch/en/td-net/Publikationen/Publikationen-td-net/mainColumnParagraphs/08/text_files/file2/document/knowledgeforms_principles.pdf

Popa, F., Guillermin, M. and Dedeurwaerdere, T. (2015) 'A pragmatist approach to transdisciplinarity in sustainability research: From complex systems theory to reflexive science', *Futures*. doi: 10.1016/j.futures.2014.02.002.

Robèrt, K. H. et al. (2002) 'Strategic sustainable development: Selection, design and synergies of applied tools', *Journal of Cleaner Production*, 10(3), pp. 197–214. doi: 10.1016/S0959-6526(01)00061-0.

Schaltegger, S., Beckmann, M. and Hansen, E. G. (2013) 'Transdisciplinarity in corporate sustainability: Mapping the field', *Business Strategy and the Environment*. John Wiley & Sons Ltd, 22(4), pp. 219–229. doi: 10.1002/bse.1772.

Scholz, R. and Tietje, O. (2012) *Embedded Case Study Methods*. Thousand Oaks, CA: SAGE Publications. doi: 10.4135/9781412984027.

Singh, R. K. et al. (2012) 'An overview of sustainability assessment methodologies', *Ecological Indicators*. doi: 10.1016/j.ecolind.2011.01.007.

Stokols, D. (2006) 'Toward a science of transdisciplinary action research', *American Journal of Community Psychology*, 38(1–2), pp. 63–77. doi: 10.1007/s10464-006-9060-5.

United Nations General Assembly (2015) 'Transforming our world: The 2030 agenda for sustainable development', (1), pp. 1–5. doi: 10.1007/s13398-014-0173-7.2. https://sustainabledevelopment.un.org/content/documents/7891Transforming%20Our%20World.pdf.

Vildåsen, S. S., Keitsch, M. and Fet, A. M. (2017) 'Clarifying the epistemology of corporate sustainability', *Ecological Economics*, 138, pp. 40–46. doi: 10.1016/j.ecolecon.2017.03.029.

Paper 3

Book chapter:

"Helping business contribute to a sustainability transition: Archetypes of business models for sustainability"

Haley Knudson and Martina Maria Keitsch

Annik Magerholm Fet
Editor

Business Transitions: A Path to Sustainability

The CapSEM Model

Springer

Editor
Annik Magerholm Fet
Department of International Business
NTNU
Ålesund, Norway

ISBN 978-3-031-22244-3 ISBN 978-3-031-22245-0 (eBook)
https://doi.org/10.1007/978-3-031-22245-0

This work was supported by Norwegian University of Sciences and Technology (974767880).

Cover illustration: The frontpage photo is taken by photographer Geir Mogen.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Chapter 22
Helping Business Contribute to a Sustainability Transition: Archetypes of Business Models for Sustainability

Haley Knudson and Martina Keitsch

Abstract This chapter discusses business models for sustainability (BMfS). The objective for BMfS is to increase positive or decrease negative impacts of business performance on the environment and society, simultaneously providing long-term well-being of the organization and its stakeholders. The chapter looks at BMfS from a systems perspective and analyses how sustainable values are integrated into organizations' performances. Furthermore, benefits and challenges of BMfS related to capacity building, stakeholder inclusion and the scope of innovations inherent in the models are discussed. Conclusively, the chapter appraises the potential of BMfS to contribute to macro level transition to sustainability.

22.1 Introduction

Business models for sustainability (BMfS) continue to gain attention, both in academic research and in practice as a means to achieve sustainability innovation and restructuring in organizations. Business model innovation for sustainability (BMIfS) is the process of increasing positive or decreasing negative impacts on the environment and society that also allows the long-term well-being of the organization and its stakeholders (Geissdoerfer et al. 2018). The complex process requires that an organization situate itself within its network of actors to see how sustainability-focused innovations will permeate its business model (BM) activities and effects on wider society.

BMfS archetypes are introduced in Part II Chap. 9. These are common patterns of BMfS that have been categorized according to their type of sustainability innovation (Bocken et al. 2014). Based on the archetypes' guidance, organizations can identify types of innovative and strategic activities that can help infuse an existing

H. Knudson (✉) ·
Department of International Business, NTNU, Trondheim, Norway
e-mail: haley.knudson@ntnu.no

M. Keitsch
Department of Design, NTNU, Trondheim, Norway
e-mail: martina.keitsch@ntnu.no

A. M. Fet (ed.), *Business Transitions: A Path to Sustainability*,
https://doi.org/10.1007/978-3-031-22245-0_22

BM with sustainability or create a completely new model with sustainability as the core logic. The archetypes provide inspiration to organizations by demonstrating how BMfS differ from traditional BMs and innovations that have worked for others. However, the focus on one innovation mechanism or type within each archetype may encourage a limited view to sustainability innovation in BMs, which in turn may influence the sustainability perception and performance in the organization. Taking only the archetypes perspective may also hinder the full integration of sustainability into an organization's value proposition, value creation and delivery, and value capture activities – preventing the creation of a business model that helps mediate environmental and social needs. On the other hand, more holistic archetype implementation, i.e., models which provide ways to infuse stakeholder needs and environmental objectives through the whole business model, can enhance organizations' sustainability performances significantly on a systems level.

The transition to sustainability and meeting the objectives set by the UN Sustainable Development Goals (SDGs) (United Nations General Assembly 2015) requires a holistic and transdisciplinary approach that is rooted strategically in an organization and therefore demands broader thinking than the identification and implementation of a single potential archetype. Organizations must consider their full value chain performance, including their network of stakeholders, to build and positively impact social and environmental sustainability in the long-term. Such requires the redefinition of value within the organization to include both financial and non-financial (social and environmental) value forms, and their exchange and capture within the business model (Evans et al. 2017). More holistic archetypes may therefore be identified in the future, that influence and direct the organization's sustainability awareness and performance towards the wider system of which it is part.

The next sections of this chapter discuss BMfS archetypes in relation to the following topics:

(a) The process of BMIfS and the integration of sustainable value into systemic organization performance,
(b) benefits and challenges for capacity building in organizations' sustainability and environmental management portfolios,
(c) the inclusion of stakeholders in existing and future BMfS design and realization, and
(d) the scopes of innovation embedded in the archetypes and their impact on changing societal systems.

Conclusively, their potential to contribute to developing changes and innovations at the organizational level that contribute to system-level sustainability transition is appraised.

22.2 Business Models for Sustainability

Innovation, knowledge building and strategic change for sustainability are dependent on a shift in the rationales and values that drive an organization (Laasch 2018, 2019). This requires, among others, a turn from creating value for customers and shareholders, to

creating, or at least not destroying, value for all stakeholders, including the environment and society as key players (Boons and Lüdeke-Freund 2013; Bocken et al. 2014). Stakeholders are here understood as individuals and groups, who have an interest in the situation and its development or could potentially be affected by it.

Traditional BMs have been based on a shareholder primacy perspective, selling goods and services to customers with the lowest cost to the organization to ensure the highest financial return and value added for its shareholders. A *BMfS*, on the other hand, creates value beyond the organization and its shareholders to actively integrate the needs of stakeholders into what it delivers to the customer (value proposition) along with its upstream and downstream activities and resources (value creation and delivery). Additionally, a BMfS bases itself in the exchange of social, environmental and economic value with its stakeholders and value chain actors (value capture), rather than in only financial flows of costs and benefits.

The term 'value' and its variants comprise multifocal interpretations and have has been extensively discussed in management sciences. A general definition of 'value added' is: "the difference between the value of a firm's output and the cost of the firm's inputs" and it is seen as "the key measure of corporate success" (Kay 1995) (p. 19). Value creation depends on the relative amount of value that is subjectively realized by an individual, an organization, or a society connected to the willingness to exchange a monetary amount for the value received. Moreover, a more recent 'value-creation' variant focuses, supplementary to the monetary value, on the resource-creation potential of firms considering, knowledge, innovation, social networks, and sustainable growth (Lepak et al. 2007).

BMfS are rooted in *sustainable value* that "incorporates economic, environmental and social benefits conceptualized as value forms" (Evans et al. 2017 p. 601). These value forms should then be considered within and across the BM components of value proposition, value creation and delivery, and value capture. Figure 22.1 provides examples of economic, environmental, and social value forms that contribute to sustainable value creation.

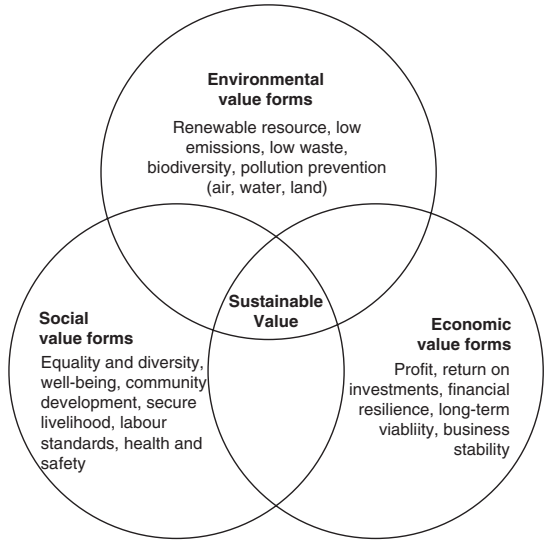


Fig. 22.1 Sustainable value. (Evans et al. 2017)

22.2.1 Business Model Innovation for Sustainability

Innovation is a process of creating new value. Because sustainability objectives require departure from the traditional logic of purely profit-making BMs, the development, adaptation and advancement of BMfS should be approached as an innovative process. Disruptive innovation is specifically interesting to develop BMfS since it transforms businesses on a systems level by, for example, making BMfS applicable for a broader range of companies, and obsoleteing more traditional competitors. Traditional business model innovation (BMI) literature, focuses on the process of the successful commercialization of new technologies or ideas through an organization's BM (Chesbrough 2007). BMIfS extends this by adding or adapting aspects, technologies and mechanisms that reduce negative and increase positive sustainability impacts in the organization's BM, and that support the long-term viability of the organization and its network of stakeholders (Boons and Lüdeke-Freund 2013; Geissdoerfer et al. 2018; Sinkovics et al. 2021).

Research on sustainability-oriented innovation has addressed several individual elements, for example, how to make supply chains more sustainable or how to use corporate responsibility activities to create value for employees and their families. Each of these technological or social innovations contribute to making the BM one that supports sustainability, but BMfS also require that the BM itself is reconceptualized to create and capture sustainable value within its wide stakeholder network (Stubbs and Cocklin 2008; Evans et al. 2017). BMIfS therefore requires changing how is business is done so that strategic aims for sustainability infiltrate the BM and its activities (Schaltegger et al. 2012a). Based on their sustainability strategy, an organization may choose to take a *defensive*, *accommodative* or *proactive* approach to innovating its BM (Schaltegger et al. 2016). These range, respectively, from making small incremental changes to mitigate risk and reduce cost, to improving internal processes that consider sustainability on some level, to the redesign of the core logic of the business for sustainable value (Schaltegger et al. 2016). It is the proactive approach that helps organizations initiate and guide a wider sustainability transition, while accommodative and defensive approaches are typically in response to top-down sustainability mandates or policies on the corporate, governmental, or societal levels. A BM with sustainability at its core requires that the business model itself is reconceptualized to create and capture sustainable value within its wide stakeholder network (Stubbs and Cocklin 2008; Evans et al. 2017).

A holistic approach that considers sustainability across the BM, and that is representative of the system of interactions between BM components and stakeholders is therefore needed (Boons and Lüdeke-Freund 2013; Abdelkafi and Täuscher 2016; Proka et al. 2018). This requires recognition of the interdependencies between an organization, its business model, its partners and surroundings, and expands the scope from small incremental modifications, to innovative change with environmental and social needs at the center (Wells 2013). BMs are the mediating layer between operational activities and organizational strategy (Osterwalder 2004; Rauter et al. 2017), and BMI processes therefore serve as a link between the internal

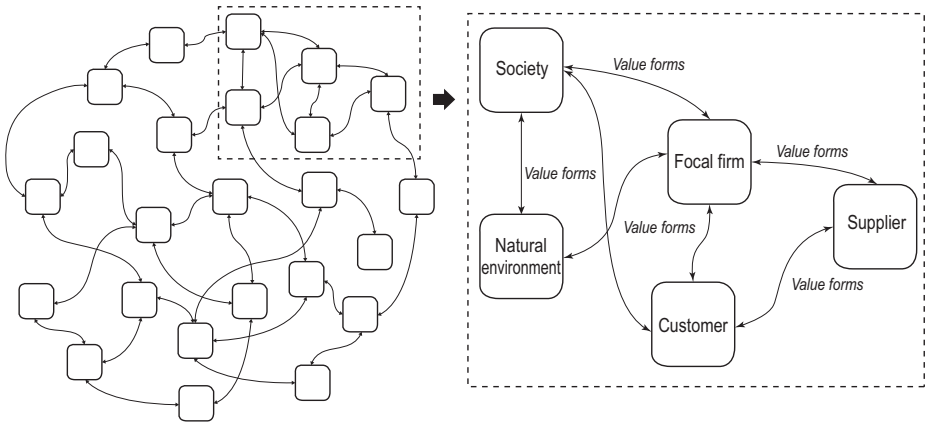


Fig. 22.2 Sustainable value network. (Evans et al. 2017)

and external business environment, strategic aims, and their operationalization in the BM structures and activities. When markets, regulations or stakeholder expectations change, the organization can then assess the system of activities that make up its value network (Zott and Amit 2010) to identify how to innovate within the BMfS in line with its strategic aims and performance objectives. Figure 22.2 provides a representation of an organization's value network in which the relationships between the focal organization and its stakeholders are shown as value forms (exhibited in Fig. 22.1). For example, relationships with societal stakeholders may bring.

The shift in ideology of the current market, from profit as the only value, to the incorporation of environmental and social value, requires, in itself, a different way of thinking that transforms the way organizations and society place value on consumption and short-term thinking. By innovating and re-designing their BMfS, organizations can contribute to environmental and social sustainability and facilitate attitude change of their consumers and stakeholders to shift demand toward sustainability. On a macro level, disruptive innovation in BMfS design is a key factor to promote, for example, a circular economy through transformation of the linear market (Diepenmaat et al. 2020).

BMI for sustainability requires the simultaneous consideration of the business model and its value network, the three dimensions of sustainable value, active engagement with stakeholders and the long-term perspective, all while organizations have to manage day-to-day operations and viability (Stubbs and Cocklin 2008). Although complex, by situating its BM within the value network, an organization can use it as a mediator between institutional and societal influences and sustainability innovation within its boundaries (Lüdeke-Freund et al. 2018; Lüdeke-Freund 2020). This enables the organization to react to external influences, such as new initiatives or regulations, and to support and incorporate stakeholder needs. The BMfS is then a framework through which organizational boundaries must expand to expose interactions with social and environmental actors in the business and institutional contexts (Boons and Lüdeke-Freund 2013; Brehmer et al. 2018).

22.2.2 Barriers to BMI for Sustainability

Business model research, and by extension BMfS research, has been conducted from multiple perspectives spanning from classification and architectures to operational and strategic mechanisms, taking both static and innovative process development approaches (Morris et al. 2005; Demil and Lecocq 2010; Foss and Saebi 2017; Ritter and Lettl 2018; Geissdoerfer et al. 2018) into account. To apply the concept of BMfS on strategic and organizational levels, it is important to move from seeing it only as an outline or architecture of the status quo, to acknowledge it as a system of interacting activities with may initiate change and contribute to innovation.

A challenging aspect of pursuing the research or implementation of a BMfS is linking the concept to practical execution by identifying feasible and appropriate opportunities and providing accessible tools. Barriers to BMI often arise because of a disconnect between the current functioning of the organization and the implementation and follow-up of new changes (Chesbrough 2010). Further, when adding sustainability considerations into the BMI process, the hurdles may be amplified. The multidimensional aspects of sustainable development can be difficult to balance and decision making between continuing opposing activities that support the financial viability of an organization yet do not support its sustainability objectives is difficult. While increasing the performance of its environmental management and sustainability portfolio can lead to the competitive advantage of a company (Kramer and Porter 2011; Schaltegger et al. 2012b), financial and human resource investments and restructuring may be required up front. When evolving the BMfS, i.e., the structures and mechanisms that allow an organization to create and capture sustainable value, the expanse of sustainability aspects and consideration of their interactions must be evaluated and monitored even more closely.

Even when an organization attempts to innovate its BMfS, successful implementation may not take place. Due to challenges related to, for example, balancing tensions between environmental, economic, and social objectives, redefining organizational logics and established norms, redistributing resources to build sustainability capacity, and establishing systems for engaging with stakeholders, a *design-implementation gap* has been identified (Evans et al. 2017; Geissdoerfer et al. 2018). Tools to assist organizations in the ideation and implementation processes of BMI for sustainability are therefore fundamental to their progress.

22.2.2.1 BMfS Archetypes as a Tool for BMI

Many tools have been developed to aid in the BMIfS process. One tool is *BMfS archetypes,* initially outlined by Bocken and colleagues in 2014 to help unify and interpret the exploding and fragmented literature on BMfS (Bocken et al. 2014). The archetypes are presented conceptually, and with reference to examples from business practice in the following sections.

The archetypes provide common models, patterns, or forms of BMfS that have been employed by other organizations. Their categorization helps to classify current knowledge on the subject and develop reference points for future research and application (Lüdeke-Freund et al. 2018). Such classification is important because the "ordering of objects into classes provides meaning to reality" and therefore helps to clarify the research area (Lambert 2015, p. 50).

Archetypes are also used as a tools for practitioners to begin thinking about how they may innovate their BMfS (Lüdeke-Freund et al. 2016; Jonker and Faber 2021). The simplicity of the archetypes allows organizations to focus on specific innovation mechanisms that they know other companies have already tested and applied, and therefore can serve as a low barrier entry point to the beginning of their innovation journey. When faced with pressure from customers, financing or regulatory bodies, organizations often want to look externally to what has worked for others as timely inspiration to their BMI process. They may therefore look to the recurring patterns of BMfS that have been successfully employed in other organizations. In the initial categorization of BMfS archetypes (Bocken et al. 2014), the models are grouped by their main innovation area – technological, social or organizational (Boons and Lüdeke-Freund 2013), and are discussed in terms of the way they seek to propose, create and capture ecological and social value. This grouping was later shifted to headings of environmental, social and economical categories (Bocken et al. 2016; Ritala et al. 2018). A ninth archetype was also added. The adapted grouping is intended to help clarify the sustainability dimension in which the new kind of sustainability innovation is occurring. Table 22.1 presents the nine archetypes along with examples and references for further reading.[1]

In terms of environmental innovation, the more technical archetypes of "maximize material and energy efficiency," "create value from waste," and "substitute with renewables and natural processes" suggest changes to the production processes, design or material selection within an organization's BM to reduce environmental impact in upstream value chain processes. In relation to the Levels of the CapSEM Model, the environmental archetypes can be considered to be representative of sustainable innovations on Levels 1 (production process-related) and 2 (product-related). Most display a closed systems perspective that sees the organization as a unit that interacts with the environment through e.g., 'pull and push' of markets. These archetypes, if not combined with wider BM changes, will lead to incremental changes and innovations, and less mature BMI for sustainability. Some advanced examples of the "create value from waste" archetype may contribute to

[1] It should be noted that these are not the only archetypes for BMfS. Another categorization of BMfS groups 45 sustainable business model patterns across 11 pattern groups based on their main value creation area (mainly economic, social-economic, social, mainly ecological, integrative) (Lüdeke-Freund et al. 2018). This taxonomy follows a more empirical and transparent methodology and was developed in response to the 'ad hoc' nature of the archetypes presented in (Bocken et al. 2014). Focusing on how and what kind of sustainable value is created may be a better way to group types of BMfS, however the taxonomy (Lüdeke-Freund et al. 2018) has not become nearly as mainstream as the archetypes (Bocken et al. 2014).

Table 22.1 BMfS archetypes

Grouping	Archetype	Examples
Environmental (Technological innovation)	**Maximize material and energy efficiency**	Low carbon manufacturing/solutions
		Lean manufacturing
		De-materialization; Digitalization
		Increased functionality; Lifespan extension
	Create value from waste	Closed loop/Cradle to Cradle
		Industrial symbioses
		Remanufacture; Take back management
	Substitute with renewables and natural processes	Renewable energy sources and innovations
		Zero emissions initiatives
		Slow manufacturing
Social (Social innovation)	**Deliver functionality rather than ownership**	Product-oriented (maintenance, extended warranty)
		Use-oriented (Renting, leasing, sharing)
		Result-oriented (Pay per use)
	Adopt a stewardship role	Biodiversity protection
		Consumer care – promoting consumer health and well-being
		Ethical trade (Fair Trade)
		Radical transparency
	Encourage sufficiency	Consumer education/communication
		Demand management
		Product longevity
		Premium branding/limited availability
Economical (Organizational innovation)	**Repurpose for society/ environment**	Not for profit
		Hybrid businesses, social enterprises (for profit)
		Alternative ownership: cooperatives, collectives
		Benefit corporations (B-corps)
		Social and biodiversity regeneration initiatives
	Inclusive value creation	Collaborative approaches (sourcing, production, lobbying)
		Peer-to-peer sharing
		Inclusive innovation; Base of the pyramid solutions
	Develop scale-up solutions	Open innovation
		Incubators and entrepreneur support
		Impact investing
		Crowd funding; Peer-to-peer lending

Modified from Bocken et al. (2016, 2019), Ritala et al. (2018)

the larger transition to a circular economy. However, since many of the existing examples suggest closed loops within a specific company or industry sector, rather than the economy at large, they are generally grouped in this analysis on the earlier Levels of the CapSEM Model.

Moving beyond environmental performance, socially innovative archetypes can be aligned with perspectives from Levels 3 and 4 of the CapSEM Model. These archetypes specifically include the consideration of stakeholder needs and larger initiatives that support sustainable development objectives and are therefore related to the higher Levels of the CapSEM Model that move beyond environmental performance to adapt BM structures in line with strategic sustainability approaches. Socially innovative archetypes focus on innovations that shift existing production and consumption patterns such as "delivering functionality rather than ownership", "establishing product sharing systems", and "adopting a stewardship role", for example by requiring suppliers to meet standards for ethics or biodiversity protection. On both the consumer and producer side, socially innovative archetypes include "encouraging sufficiency," among others, through designing products with longevity in the use phase to decrease the tendency to buy new products frequently. These archetypes progressively follow up the technological innovation archetypes that adhere to an 'accommodative' approach to organizational sustainability (Schaltegger et al. 2012b), that is, to reduce environmental impacts, and resist developing novel standards for decision-making in business. Other examples include circular economy based models that support changing production and consumption patterns, e.g., sharing platforms, product as a service, resource recovery and circular supplies (Moreno et al. 2016), and product-service system (PSS) models. These differ from the technical "create value from waste" BMs as they do more than change material, energy, and waste streams in production processes, and enable and depend on changes in upstream and downstream networks, and in producer and consumer conceptualizations of need and responsibility.

The economical archetypes demonstrate patterns of organizational innovation and can be situated on Levels 3 and 4 of the CapSEM Model. While it may seem counter-intuitive that the economic archetypes are at the higher Levels, this is due to their reconceptualization of the typical for-profit business model, that is, they make changes to the current economy in support of market and societal transition. They attempt to integrate societal norms and ethical thinking and decision-making into sustainable business strategies and solutions. Focusing on "repurposing the business for society/the environment," "inclusive value creation," and "developing scale-up solutions" supports the kind of disruptive business models needed for sustainable transition away from incumbent models (Christensen et al. 2006; Kivimaa et al. 2021). Logically, this surpasses the technological innovation archetypes by acknowledging that it is not possible to derive values for society from natural systems (Keitsch 2020a). Pragmatically, this means there is a need to relate to larger initiatives that support sustainable development objectives and to include societal stakeholders' needs, values, and norms in order to generate sustainable network impact.

Although the nine archetypes are separated and referred to individually, they must be combined to move to more holistic BMIfS that penetrates through the full

business model (Bocken et al. 2014). For example, in the case of a product sharing platform BMfS (i.e., deliver functionality rather than ownership), material and energy efficiency measures of the technical archetypes must also be part of the BM to prevent unnecessary production of exorbitant products, or risk little reduction of environmental impact. Such parallels the logic of the CapSEM Model, as the tools and methods on the higher levels require application of the tools and perspectives of the lower levels.

22.3 Discussion

The categorization of archetypes above illustrates the possibilities for implementation of BMIfS processes into the business models of real-world organizations. Using archetypes as a representation of the potential for sustainable innovation within BMs can provide organizations examples of experience and techniques from practice and help reduce the risk associated with restructuring a BM (Bocken et al. 2014). The reduced risk can help encourage organizations to attempt their own incorporation of sustainable value, through the selection and combination of different archetype principles appropriate for the particular business. The archetypal innovation strategies and mechanisms can then be considered in relation to an organization's specific value chain processes and existing business model. They can also be combined in configurations that best support the organization's sustainability strategy and stakeholder needs. When applied in practice, BMfS archetypes can be used by organizations among others as a quick fix to meet sustainability demands, without considering all aspects of sustainability and the societal and environmental impacts on a holistic scale. Some authors claim that, trapping ideas from established models may yet limit the impact of BMI outside of the organization (Morris et al. 2005; Chesbrough 2010; Demil and Lecocq 2010; Boons and Lüdeke-Freund 2013), which will be further discussed in the following.

Improving sustainability performance and innovating BMs for sustainability helps organizations support and incorporate macro-level sustainability objectives into their activities. To design, implement, or transit to a BMfS, organizations must implement activities that make their business model one that promotes sustainable innovation and that contributes to sustainable development in the larger system of which it is part (Diepenmaat et al. 2020), not only in the organizational unit. While archetypes may help direct the identification of sustainable innovation opportunities, they may also lead to ignorance of the entire set of activities and interactions that make up the organization's BM. It is therefore required that the organization also views its BM as a system of activities (Zott and Amit 2010; Evans et al. 2017), with interdependencies between activities, to create a comprehensive picture of how it operates within its multilevel context. Incremental choices that impact one activity and the achievement of its purpose may positively or negatively affect other activities, therefore impacting or changing the accomplishment of the overall objective of the value proposition for the customer and stakeholders.

From a systems perspective, socially innovative archetypes are the most advanced systems. They represent BMfS that are 'autopoetic,' i.e. that perceive business as an 'ecosystem', embedded in a network of other entities, or 'subsystems'. Their rationale is that business evolves and thrives not just together with other businesses but also through interdependencies and in interaction with various subsystems (Valentinov 2014). Moving towards CapSEM Model Level 4, the socially innovative archetypes expand the structure of business interactions, and design new types of exchanges among organizations and societal stakeholders. Moving to an autopoetic systems literacy allows sectors and industries to realize the interconnected structure of organizations, technologies, consumers and products (Kohtamäki et al. 2006; Keitsch 2012).

In terms of sustainability performance, businesses oriented toward organizational innovation may commonly develop incentives and a vision to strive for sustainability goals, develop individual initiatives while using political mechanisms to ensure that their activities will reach these goals, and coordinate the internal with the external pace of innovation (Anggraeni et al. 2007). The economical archetypes, then, can support the complete reformation of traditional make-and-sell BMs through organizational level innovation. For example, to 'repurpose the organization for the society and/or environment,' as, e.g., not for profit organizations or social enterprises, or to 'develop scale-up solutions' to sustainability that reduce competition and increase collaboration among organizations in support of open innovation initiatives, industrial cluster formation or crowd-sourced models. Economical archetypes focused on organizational innovation allow actors to revise their value orientations and innovate their business models as results of novel activities, roles and structures. The societal context of businesses is even more emphasized in organizational innovation archetypes and the mutal influence of business and societal stakeholders is explained in close context to socio-cultural innovation via new partnerships, business-citizen initiatives such as Open innovation platforms and transdisciplinary collaboration (Keitsch 2020b). These archetypes put stakeholder collaboration in the forefront in co-developing sustainability knowledge and -implementation strategies. The aim is to achieve 'sustainable well-being' of all societal stakeholders by aligning business strategies and solutions to ethical principles defined by social systems, institutions, and environments. The 'common good' of sustainable well-being is heuristic, it assumes that even if assumptions, expectations, attitudes, values, and interests that influence decisions vary greatly in societies, consent is possible.

The *repurpose for society and the environment*, and the *development of scale up solutions* in the table above illustrate the aim of sustainable well-being as one onset for the organizational innovation archetypes. In terms of disruptive innovation, these archetypes can complement policy and social groups efforts to support the transformation necessary to achieve sustainable societies. For example, the scale up solutions might bring major benefits for society by including larger populations, and new groups in the development process. As Iizuka and colleagues (2021: 16) point out: 'Disruptive inclusive innovation (DII) " …. can be initiated by the private sector without much government involvement. Entrepreneurs respond to the unmet

demands of citizens by devising an innovative business model, linking the underserved population with new services using emerging technologies to generate broader impacts".

22.4 Conclusion

Implementing and examining the full portfolio of sustainability needs and requirements that result from the activities within the business model can help an organization change or adapt its BMfS to create more disruptive and inclusive social and environmental impact. While archetypes are useful for ideation and experimentation, it is essential that they are inserted into the understanding of the business model as a whole. This entails considering innovation archetypes within the network of activities and actors that make up the current BM, identifying the expected impacts on stakeholders, and determining the contribution to the organization's sustainability performance (i.e. 'autopoetically'). This is supported by the definition of BMIfS provided by Bocken et al. (2014) in their archetype work: "Innovations that create significant positive and/or significantly reduced negative impacts for the environment and/or society, through changes in the way the organisation and its value-network create, deliver value and capture value (i.e. create economic value) or change their value propositions" (p. 44). However, consideration and integration into the wider value network of stakeholders is often hindered due to, for example, the challenges of the 'design-implementation gap' between ideation and implementation of BMfS (Geissdoerfer et al. 2018), the fundamental shift of core business logics from profit-making to sustainability creating (Laasch 2018) or a limited understanding of the dynamics of the process of BMIfS (Lüdeke-Freund 2020).

The question remains, if moving towards BMfS with the help of the archetypes will apply to every organization in a shifting market. Especially small and medium sized organizations that are not able to integrate insights from subsequent research and experience and may end up using tools that do not benefit their context, reducing their chances of success. For this reason, structural support in the form of, for example, transdisciplinary stakeholder collaboration, is essential to mitigate failures and achieve systemic macro level sustainability, a view that will be further elaborated in the next chapter.

References

Abdelkafi N, Täuscher K (2016) Business models for sustainability from a system dynamics perspective. Organ Environ 29(1):74–96. https://doi.org/10.1177/1086026615592930

Anggraeni E, den Hartigh E, Zegveld M (2007) Business ecosystem as a perspective for studying the relations between firms and their business networks. In: Phase transitions in ortanisations, pp 1–21

Bergmann T, Utikal H (2021) How to support start-ups in developing a sustainable business model: the case of an European social impact accelerator. Sustainability 13(6):3337. https://doi.org/10.3390/su13063337

Bocken N, Boons F, Baldassarre B (2019) Sustainable business model experimentation by understanding ecologies of business models. J Clean Prod 208:1498–1512. https://doi.org/10.1016/j.jclepro.2018.10.159

Bocken NMP, Short SW, Rana P, Evans S (2014) A literature and practice review to develop sustainable business model archetypes. J Clean Prod 65:42–56. https://doi.org/10.1016/j.jclepro.2013.11.039

Bocken NMP, Weissbrod I, Tennant M (2016) Business model experimentation for sustainability. In: Setchi R, Howlett RJ, Liu Y, Theobald P (eds) Sustainable design and manufacturing 2016. Springer International Publishing, Cham, pp 297–306

Boons F, Lüdeke-Freund F (2013) Business models for sustainable innovation: state-of-the-art and steps towards a research agenda. J Clean Prod 45:9–19. https://doi.org/10.1016/j.jclepro.2012.07.007

Brehmer M, Podoynitsyna K, Langerak F (2018) Sustainable business models as boundary-spanning systems of value transfers. J Clean Prod 172:4514–4531. https://doi.org/10.1016/j.jclepro.2017.11.083

Chesbrough H (2010) Business model innovation: opportunities and barriers. Long Range Plan 43(2–3):354–363. https://doi.org/10.1016/j.lrp.2009.07.010

Chesbrough HW (2007) Why companies should have open business models. MIT Sloan Manag Rev. https://doi.org/10.1111/j.1540-5885.2008.00309_1.x

Christensen CM, Baumann H, Ruggles R, Sadtler TM (2006) Disruptive innovation for social change. Harv Bus Rev 9

Demil B, Lecocq X (2010) Business model evolution: in search of dynamic consistency. Long Range Plan 43:227–246. https://doi.org/10.1016/j.lrp.2010.02.004

Diepenmaat H, Kemp R, Velter M (2020) Why sustainable development requires societal innovation and cannot be achieved without this. Sustainability 12(3):1270. https://doi.org/10.3390/su12031270

Evans S, Vladimirova D, Holgado M, Van Fossen K, Yang M, Silva EA, Barlow CY (2017) Business model innovation for sustainability: towards a unified perspective for creation of sustainable business models. Bus Strateg Environ 26(5):597–608. https://doi.org/10.1002/bse.1939

Foss NJ, Saebi T (2017) Fifteen years of research on business model innovation: how far have we come, and where should we go? J Manag 43(1):200–227. https://doi.org/10.1177/0149206316675927

Geissdoerfer M, Vladimirova D, Evans S (2018) Sustainable business model innovation: a review. J Clean Prod 198:401–416. https://doi.org/10.1016/J.JCLEPRO.2018.06.240

Iizuka M, Hane G (2021) Towards attaining the SDGs: cases of disruptive and inclusive innovations. Null 11:1–22. https://doi.org/10.1080/2157930X.2021.1954751

Jonker J, Faber N (2021) Organizing for sustainability: a guide to developing new business models. Springer Nature

Kay J (1995) Foundations of corporate success: how business strategies add value. Oxford University Press, Oxford

Keitsch MM (2020a) Enhancing collaboration between societal stakeholders for reduced inequalities. In: Leal Filho W, Azul AM, Brandli L, Lange Salvia A, Özuyar PG, Wall T (eds) Reduced inequalities. Springer International Publishing, Cham, pp 1–14

Keitsch MM (2020b) Transdisciplinary collaboration and ethics. In: Keitsch MM, Vermeulen WJV (eds) Transdisciplinarity for sustainability. Routledge

Keitsch MM (2012) Sustainable design: a brief appraisal of its Main concepts. Sustain Dev 20(3):180–188. https://doi.org/10.1002/sd.1534

Kivimaa P, Laakso S, Lonkila A, Kaljonen M (2021) Moving beyond disruptive innovation: a review of disruption in sustainability transitions. Environ Innov Soc Trans 38:110–126. https://doi.org/10.1016/j.eist.2020.12.001

Klofsten M, Bienkowska D (2021) Business incubators within entrepreneurial ecosystems: sustainability aspects of new venture support and development. Handbook of Research on Business and Technology Incubation and Acceleration

Kohtamäki M, Vesalainen J, Varamäki E, Vuorinen T (2006) The governance of partnerships and a strategic network: supplier actors' experiences in the governance by the customers. Manag Decis 44:1031–1051. https://doi.org/10.1108/00251740610690603

Kramer MR, Porter ME (2011) Creating shared value. Harv Bus Rev:3–17

Laasch O (2018) Beyond the purely commercial business model: organizational value logics and the heterogeneity of sustainability business models. Long Range Plan 51(1):158–183. https://doi.org/10.1016/J.LRP.2017.09.002

Laasch O (2019) An actor-network perspective on business models: how 'being responsible' led to incremental but pervasive change. Long Range Plan 52(3):406–426. https://doi.org/10.1016/J.LRP.2018.04.002

Lambert S (2015) The importance of classification to business model research. J Bus Model 3(1). https://doi.org/10.5278/ojs.jbm.v3i1.1045

Lepak DP, Smith KG, Taylor MS (2007) Value creation and value capture: a multilevel perspective. AMR 32(1):180–194. https://doi.org/10.5465/amr.2007.23464011

Lüdeke-Freund F (2020) Sustainable entrepreneurship, innovation, and business models: integrative framework and propositions for future research. Bus Strateg Environ 29(2):665–681. https://doi.org/10.1002/bse.2396

Lüdeke-Freund F, Carroux S, Joyce A, Massa L, Breuer H (2018) The sustainable business model pattern taxonomy – 45 patterns to support sustainability-oriented business model innovation. Sustain Prod Consum 15:145–162. https://doi.org/10.1016/j.spc.2018.06.004

Lüdeke-Freund F, Massa L, Bocken N, Brent A, Musango J (2016) Main report: business models for shared value. Network for Business Sustainability South Africa

Millette S, Eiríkur Hull C, Williams E (2020) Business incubators as effective tools for driving circular economy. J Clean Prod 266:121999. https://doi.org/10.1016/j.jclepro.2020.121999

Moreno M, De los Rios C, Rowe Z, Charnley F (2016) A conceptual framework for circular design. Sustain (Switz) 8(9). https://doi.org/10.3390/su8090937

Morris M, Schindehutte M, Allen J (2005) The entrepreneur's business model: toward a unified perspective. J Bus Res 58:726–735. https://doi.org/10.1016/j.jbusres.2003.11.001

Osterwalder A (2004) The business model ontology a proposition in a design science approach. Doctoral Dissertation, Université de Lausanne, Faculté des hautes études commerciales

Proka A, Beers PJ, Loorbach D (2018) Transformative business models for sustainability transitions. Springer, Cham, pp 19–39

Rauter R, Jonker J, Baumgartner RJ (2017) Going one's own way: drivers in developing business models for sustainability. J Clean Prod 140:144–154. https://doi.org/10.1016/j.jclepro.2015.04.104

Ritala P, Huotari P, Bocken N, Albareda L, Puumalainen K (2018) Sustainable business model adoption among S & P 500 firms: a longitudinal content analysis study. J Clean Prod 170:216–226. https://doi.org/10.1016/j.jclepro.2017.09.159

Ritter T, Lettl C (2018) The wider implications of business-model research. Long Range Plan 51:1–8

Schaltegger S, Hansen EG, Lüdeke-Freund F (2016) Business models for sustainability: origins, present research, and future avenues. Organ Environ 29(1):3–10. https://doi.org/10.1177/1086026615599806

Schaltegger S, Lüdeke-Freund F, Hansen EG (2012a) Business cases for sustainability: the role of business model innovation for corporate sustainability. IJISD 6(2):95. https://doi.org/10.1504/IJISD.2012.046944

Schaltegger S, Lüdeke-Freund F, Hansen EG (2012b) Business cases for sustainability and the role of business model innovation: developing a conceptual framework. Ssrn. https://doi.org/10.2139/ssrn.2010506

Sinkovics N, Gunaratne D, Sinkovics RR, Molina-Castillo F-J (2021) Sustainable business model innovation: an umbrella review. Sustainability 13(13):7266. https://doi.org/10.3390/su13137266

Stubbs W, Cocklin C (2008) Conceptualizing a "sustainability business model.". Organ Environ 21(2):103–127. https://doi.org/10.1177/1086026608318042

United Nations General Assembly (2015) Transforming our world: The 2030 agenda for sustainable development. https://sustainabledevelopment.un.org/content/documents/7891Transforming%20Our%20World pdf (1):1–5. https://doi.org/10.1007/s13398-014-0173-7.2

Valentinov V (2014) The complexity–sustainability trade-off in Niklas Luhmann's social systems theory. Syst Res Behav Sci 31(1):14–22. https://doi.org/10.1002/sres.2146

Wells P (2013) Sustainable business models and the automotive industry: a commentary. IIMB Manag Rev 25:228–239. https://doi.org/10.1016/j.iimb.2013.07.001

Zott C, Amit R (2010) Business model design: an activity system perspective. Long Range Plan 43(2–3):216–226. https://doi.org/10.1016/j.lrp.2009.07.004

Paper 4

Working paper:

"Examining institutional influences and values in sustainability management"

Haley Knudson

Examining institutional influences and values in sustainability management

Haley Knudson

1. Introduction

Organizations conform with their institutional context to signal their legitimacy. Sustainability breaks with the dominant market logic and therefore necessitates organizations operate within contexts of institutional pluralism and institutional complexity (Laasch, 2018; Radoynovska, Ocasio, & Laasch, 2020). These complex combinations of logics can conflict with each other and make it difficult to determine the best management and operational plans to meet contradictory norms. To address plural objectives, organizations must situate themselves within their institutional context to clarify their sustainability goals and recognize interactions and influences from institutional actors.

Sustainability management concerns the processes and strategies that organizations use to integrate sustainable development objectives into their business models. It demands the management of environmental, social, and economic sustainability issues within the organization, and the alignment of these activities with the organization's strategy and business goals (Schaltegger, 2013). Sustainability management is sometimes used synonymously with corporate social responsibility (CSR), corporate responsibility or environmental management. There are many approaches to the integration of sustainability principles and objectives into organizational strategy and business models, and the process has been studied from varying angles. Defining characteristics include the incorporation of financial and non-financial (environmental and social) value into the organization, taking a long-term perspective, and active engagement and consideration of stakeholders (e.g., Schaltegger 2013; Geissdoerfer et al. 2018; Lüdeke-Freund 2020). The maturity or performance level of an organization's sustainability strategy can be categorized along a spectrum ranging from weak defensive sustainability, in response to external pressures and to avoid risk of noncompliance, to strong proactive sustainability, which integrates long-term perspectives of regeneration and stakeholder engagement into the core logic driving the organization (e.g., Baumgartner and Ebner 2010; Landrum 2018).

Institutional theory (Meyer and Rowan 1977; DiMaggio and Powell 1983) is a valuable perspective for understanding sustainability management because it helps clarify the multilevel context in which sustainability decisions must be made. Organizations cannot be sustainable on their own and require positioning and connecting themselves to other actors and resources within the system(s) in which they operate (Jennings & Zandbergen, 1995). Further, institutionalization is the process of how norms and values become institutionalized within these systems, and how they change as result of shifting contexts. Aspects of the institutional logic perspective supplement the understanding of how practices, values and assumptions guide and constrain organizational behavior within an institutional context – and the challenges that arise as logics, and their dominance and combination, change.

This paper therefore explores the link between aspects of institutional theory and sustainability management. The next section introduces institutional theory and facets of institutionalization and institutional logics as they relate to the development of sustainable management practices. Then, using two illustrative business examples, the impacts of different institutional influences are discussed across the sustainable management practices and contexts of the selected organizations.

2. Institutional theory

Institutional theory extends resource-based explanations of organization differentiation and competitive advantage to describe the effects of complex networks and common beliefs and norms on organizations (Meyer and Rowan 1977). Organizations operate within and are influenced by their *institutional context*, constituted by "the rules, norms and ideologies of the wider society" (Meyer and Rowan 1983 p. 84) and "common understandings of what is appropriate and, fundamentally, meaningful behavior" (Zucker 1983 p. 5). These common understandings and norms are institutions themselves and combine in their institutional context to create a system of accepted social behavior that may be taken-for-granted or formalized.

According to institutional theory, there are two forces influencing organizational behavior (Meyer & Rowan, 1977; Scott, 1983). First, the complex networks that make up institutional contexts and are made up of relationships between actors that shape institutions. Second, the desire of organizations to conform to their institutional context and its institutions to gain *legitimacy* and license to operate. DiMaggio and Powell (1983) coined the process of conforming to accepted rationalizations of appropriate behavior as *isomorphism*. These two

forces act in a dynamic relationship where interactions within networks create rationalized myths, complexity within networks leads to different responses to rationalized myths, and these responses then lead to differences in organizations and changes in rationalized myths (DiMaggio & Powell, 1983; Greenwood, Oliver, Suddaby, & Sahlin-Andersson, 2012; Meyer & Rowan, 1977; Scott, 1983). This understanding of organizations therefore considers the impacts and complexity of interactions within networks of actors influenced by varying, and sometimes conflicting, pressures and beliefs – a key perspective for understanding the intricacy of sustainability management.

2.1 Society as an inter-institutional system

Differentiation between societal levels is essential in the discussion of the multilevel challenge of sustainability. Friedland and Alford's (1991) description of society as an *inter-institutional system*, illustrated in Figure 1, is therefore helpful in the application of an institutional lens to sustainability management. The distinction helps explain the multi-scale problem of sustainable development and the range of approaches and strategies toward sustainable business. In this context, organizations feel both regulatory pressure and organizational opportunity for proactive differentiation amid markets changing toward more socially or environmentally friendly practices.

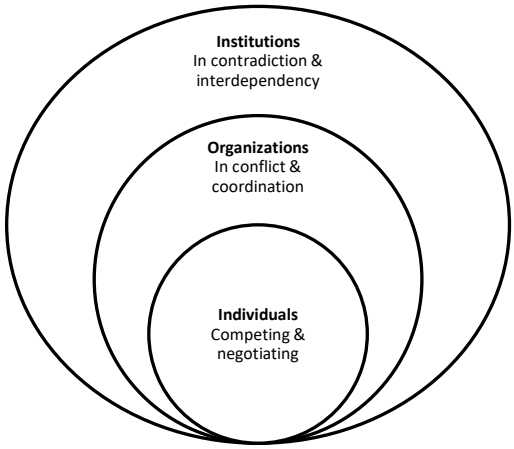


Figure 1: Society as an inter-institutional system (drawn based on Friedland and Alford (1991))

2.2 Three pillars of institutions

There are three pillars through which aspects of institutional theory can be examined – the regulative, the normative, and the cultural-cognitive (Scott, 1995). While the pillars are helpful to distinguish between different strands of institutional analysis for a particular context, they must also be considered and analyzed in conjunction as each impacts and reacts to the others. As Scott (2001) explains, institutions are comprised of different combinations of "cultural-cognitive, normative and regulative elements that, together with associated activities and resources, provide stability and meaning to social life" (p. 48). Table 1 presents Scott's conceptual framework and explains the variations through which each pillar bases its aspects of compliance, order, and legitimacy. The *regulative pillar* surrounds action guided by influential organizations through coercive mechanisms and the threat of formal sanction. These powerful instruments guide institutional change toward what is considered right in the society under study, i.e., formal rule systems and their enforcement. The *normative pillar* concerns social obligations, morally governed expectations for what is ethical and acceptable, and suggests appropriate behavior in that institutional context. Culturally determined beliefs and values make up the *cultural-cognitive pillar*. Depending on the context, different culturally supported frames suggest how to interpret that very society, e.g., religions' influence on societal structures. Some scholars assert that the cultural-cognitive pillar is most important for the study of institutions because it is the arena in which the foundation for beliefs, norms, and values, are based (Scott 2005; Phillips and Malhotra 2012).

Table 1: Three pillars of institutions (adapted from Scott (1995, 2001, 2005))

	Regulative	***Normative***	***Cultural-cognitive***
Basis of compliance	Expedience	Social obligation	• Taken for granted-ness • Shared understanding
Basis of order	Regulative rule	Binding expectations	Constitutive schema
Mechanisms of diffusion	Coercive	Normative	Mimetic
Indicators	• Rules • Laws • Sanctions	• Certification • Accreditation	• Common beliefs • Shared logics of action
Basis of legitimacy	Legally sanctioned	Morally governed	• Comprehensible • Recognizable • Culturally supported
Action guided through	• Coercion • Threat of formal sanction	• Norms of acceptability • Morality • Ethics	Categories and frames by which actors know and interpret their worlds

2.3 Institutionalization

The transition to more sustainable business practices and permeation of responsible management is a process away from the current status quo. It is therefore helpful to apply a similar processual lens towards institutional theory. *Institutionalization* is the process by which "social processes, obligations, or actualities come to take on rule-like status in social thought and action" (Meyer and Rowan 1977 p.341). When norms, activities or structures become taken-for-granted, widely accepted, and exhibit aspects of permanence, they can be considered to be institutionalized (Tolbert and Zucker 1983 p. 25).

Institutionalization occurs through three 'mechanisms of diffusion': *coercive*, when external actors force organizations to conform to specific elements, such as regulations and laws; *normative*, when organizations want to be perceived as professional or ethical, such as certification or accreditation*;* and *mimetic*, when organizations want to imitate what seems to work for others and/or want to avoid being seen as not following common and accepted beliefs (DiMaggio & Powell, 1983). These mechanisms also align with the three pillars of institutions (Scott, 1995, 2005). While sometimes referred to as 'pressures', diffusion mechanisms are further referred to in this paper as 'influences' to avoid any negative connotation and to highlight the two-way relationship between actors and beliefs and norms.

Different diffusion mechanisms interject diverse institutional influences onto organizations and their resulting sustainability practices and activities. Organizations are therefore influenced by the three types of influences that result from their operation in the institutional context of which they are part. This may vary based on several factors including their position in their network, their organizational field, industrial sector, or geographical location. Sustainability regulations mandate and *coerce* an organization to meet certain objectives. Environmental and social certification or standardization schemes encourage and commit companies to meet voluntary objectives, allowing them to show their *normative* commitment to improving society. Looking to first movers, organizations who decide to commit ahead of or beyond regulatory pressures, and seeing their success provides a reason for organizations to *imitate* approaches. Once widely implemented in an organizational field, what were once first-mover approaches may become part of the shared understanding of what is appropriate business and transition into normative or regulatory expectations.

Unfortunately, the current alignment of normative value and the degree of regulation does not align with the importance of corporate sustainability practices and management. The most

coercive sustainability practices, once adopted, tend to lose the meaning behind their reason for adoption. The commitment is no longer to be sustainable, but to avoid sanctions (Jennings & Zandbergen, 1995). An organization that begins or ends with a coerced sustainability strategy is likely to equate the least value with it. Further, the practices that result from more coerced diffusion, are less likely to be disseminated or attractive to actors in other fields (Jennings & Zandbergen, 1995). Amid the current sustainability crisis, however, getting organizations to reduce negative environmental impacts by any means necessary may be the only way for timely change.

Additionally, structural and historical elements may direct the way an organization makes decisions to comply, or not, to institutional rules or structures. For instance, when technical efficiency is threatened by institutional isomorphism, i.e., conforming with a certain influence, the organization may decouple its symbolic activities from its technical or operation activities (Meyer & Scott, 1983; Zucker, 1983). Such is illustrated through the example of green washing, in which organizations adopt surface level sustainability initiatives without thoroughly transforming their production processes or business models. A more nuanced linkage may be to the scale of approaches organizations take toward sustainability, from weak reactive and incremental movements to strong holistic and embedded strategies. The way and degree to which an organization conforms to institutional influences in complex environments can be better understood through the idea of institutional logics, described in the next section.

2.4 The institutional logics perspective

The institutional logics perspective provides a framework to analyze the interrelationships between patterns of beliefs and values, known as *logics*, on multiple levels of social systems, from the individual to the group, the organization and the institution (Durand & Thornton, 2018; Friedland & Alford, 1991). Institutional logics are "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (p. 804). Institutional logics, such as those of the market, the state, or the family, are each created and constrained by coercive, normative, and symbolic dimensions (Thornton & Ocasio, 1999, 2012). Institutions form and influence the logics represented by patterns of rules, laws, and expected and appropriate behavior that become taken for granted and inherent to that logic (Zucker, 1987). Again, there is a multidirectional relationship that dynamically defines what is and is not appropriate and accepted within each

institutional context. A key takeaway of the institutional logics approach, therefore, is that institutions both constrain organizations and provide them motivation and agency for change (Thornton & Ocasio, 2012).

Institutional logics exist on multiple levels, from macro-level logics, such as Thornton's (2004) six Western society-level logics (families, religions, states, markets, professions, and corporations), to organizational level logics (the combination of specific society level logic(s) that organizations use to form their values and guide their decisions), and individual level logics (the societal and organizational level logics that guide and develop an individual's beliefs). Actors within each of the levels extract and develop their values through a combination of logics, for example, the market, the state, family, and religion, which inform their resulting actions. The institutional logics upon which organizations rest their values and decision making are referred to as 'organizational value logics' (Laasch, 2018). Organizational value logics are tied directly to the multilevel institutional context in which the organization operates, and represent the value institutionalized within the organization.

Parallelly, even within the same societal contexts and influenced by the same institutions, organizations are not homogeneous. Aspects of the individual level, such as *agency* and *leadership*, are also then key in understanding institutional logics and organizational decision-making. According to Thornton and Ocasio (2012), "perhaps the core assumption of the institutional logics approach is that the interests, identities, values, and assumptions of individuals and organizations are embedded within prevailing institutional logics" (p. 103). This means that while individuals and organizations do have rational choice and agency, such is embedded in the societal context in which they operate (Greenwood and Suddaby 2006). In an organizational context, tensions between logics and organizational values must be managed through clear strategies and objectives. The experiences of organizations challenged by incompatible institutional logics creates institutional complexity (Greenwood, Raynard, Kodeih, Micelotta, & Lounsbury, 2011). Management and leadership decisions must therefore be viewed not only from the perspective of the individual's and/or organization's norms and values, but in conjunction with distinguishing characteristics of the institutional logic(s) that influences those norms and values.

2.4.1 Institutional logics and sustainability

In a context of competing institutional logics, organizations must find ways to address tensions between values and make decisions within a space of sometimes incompatible logics while still maintaining the organization's identity (Askeland, 2020; Selznick, 1957). An analysis of competing organizational logics, exposes the difficulties that may be associated with an organization's shift toward stronger sustainability. The current dominant logic driving organizations is the market logic, rooted in neo-classical economics and driven by capitalist efficiency, financial value creation and shareholder primacy (Friedland & Alford, 1991; Laasch, 2018). A sustainability logic, based on regeneration, stakeholder inclusion, and non-financial value creation therefore occurs in opposition. While most organizations exist in a context of institutional pluralism (i.e., a context of multiple institutional logics that simultaneously impose different systems of rules, values, and norms (Kraatz & Block, 2008)), the more the logics are in disagreement, the harder the organization must fight to define, maintain, and adapt its organizational value logic to establish and preserve its legitimacy.

Institutional logics at the societal level affect the logics and business model decisions at the organization level (Thornton & Ocasio, 2012). Inherent to the sustainability logic is its foundation in the highest societal level. It requires the consideration of global biological systems and processes, and their effects on society and the environment across the globe. It also demands the recognition of humanity's impacts on these processes. Organizations are tasked with the challenge of situating the meta sustainability logic within their organization and finding their place within it. The complexity of this context poses clear challenges, and a setting in which organizations need a defined identity and strategy to base their decisions. Tensions identified between the market and sustainability logics include: a value proposition that addresses the needs of wider stakeholders and not only customers; financial versus non-financial value creation and value exchange processes based in relationships beyond financial transactions; continuous growth versus the necessary scale within a more sustainable society, and; redistribution of social, environmental, and economic value rather than maximum economic profit (Laasch 2018 p. 173). As the logics of environmental and social responsibility become further institutionalized on the societal level, organizations and their managers must translate sustainability aspects on global, regional, and local scales into their organizational level strategies.

3. Business examples

The following business examples illustrate the multilevel context in which organizational values are defined and decisions made toward sustainable business. After an introduction to the companies, the main institutional logics that guide each's organizational strategy are discussed. Different institutional influences on their sustainability approaches are then examined across coercive, normative, and mimetic levels. Data for the examples was collected through publicly available materials, such as websites and company profiles, and informal interviews. The examples present cases in different institutional contexts, with different values, different structures, and different approaches to sustainability.

3.1 Nordic Comfort Products (NCP)

Nordic Comfort Products (NCP) is a furniture designer and manufacturer located near the Arctic Circle in Hemnesberget, Norway. Founded in 1932, the company originally produced steel pipe furniture for the public market and transitioned to incorporating plastic into their products as it became more widely available. NCP operates in the B2B space, and public customers, such as schools and public offices, continue to be their main customer, in addition to restaurants and hotels. Its products reach these customers mainly through furniture dealers, with some direct sales. NCP has 18 employees and an operating revenue (2019) nearing USD4.4 million (proff.no, n.d.).

NCP began its work for sustainability in 2017 with a research study on alternative sources for virgin plastic. They were guided by the understanding that their main material input will run out and the long-term vision of being a first mover for a "common and shared future" (Skjæran, 2021a). Partnering with Norway's largest research institution, and inspired by the growing push for circular practices in Norway, the study investigated how different types of plastic waste from the fishing industry could be used as input in their manufacturing processes. The study showed potential, so, with a grant from the state-funded innovation organization, and a year of R&D, NCP was able to invest in new injection molding technology that could best utilize the recycled input plastic. With the support of the grant and a new production line, they redesigned a classic chair and began producing the S-1500 with a seat made entirely of recycled plastic from local fish farms and a frame of 20% recycled Norwegian steel. Each S-1500 helps to remove 1500 grams of plastic waste like waste nets, rope, and pipe. It is available in eight 'Ocean colors' that result from the type of plastic fishing gear recycled. The S-1500 is the result

of a partnership between NCP (the producers), a Norwegian architecture firm (the designers), and two fish farms (the plastic suppliers). The chair was launched in February 2019, and while receiving great attention from the design world, faced some challenges with sales. Because the price is higher than their other product lines made from virgin materials and traditional manufacturing processes, their customers have been less likely to purchase the more expensive product. Local sourcing and production further make it difficult for NCP to compete with producers in China, Taiwan, and Malaysia on price – the main determinant for most customers, even though those producers have no environmental documentation or certification. According to NCP (Skjæran, 2021a, 2021b), the lack of regulatory support to encourage customers to purchase their recycled products is their greatest sustainability challenge. Even though the state-owned and funded Innovation Norway sponsored their R&D and new production line, state requirements or incentives for public procurement do not support the purchase of the end product.

Even with these challenges, NCP has now extended two of their existing product lines to offer seats from recycled aquaculture plastics instead of their usual virgin plastic. In addition, another chair is produced with a seat made from recycled plastic from NCP's own production and can also be ordered with an Ocean plastic seat. As of March 2021, NCP has recycled 200 tons of plastic waste from their local area and has the objective to be fully circular by 2030 (Skjæran, 2021a).

3.1.1 Institutional influences for sustainability

NCP was established and currently operates as a traditional manufacturing company under a dominant market logic. In addition, growing awareness of the sustainability crisis, on both the State and organizational levels, has motivated the company to align itself with a long-term and regenerative sustainability logic. Its vision is to have a fully circular product line by 2030, using only recycled material inputs for all its furniture products (Skjæran, 2021a). Additional circularity strategies for the end of use phase, such as component replacement, repair, and remanufacturing, have also been discussed (Skjæran, 2021b). These sustainability initiatives depend, however, on NCP's ability to align the higher prices of its environmental products with the price customers are willing to pay, and to do so on a scale that produces a profit that can support its continued operation. NCP's organizational value logic has been shaped in the space between these two logics, because of different institutional mechanisms that have driven its decision making.

On the coercive level, the availability of funding from state-sponsored innovation incubators signals that circular and sustainable business practices will be valued on the institutional level of society. This indicates the possibility to get ahead of competitors and adapt to future requirements for legitimacy. In addition, NCP's membership in cluster organizations encourages the company's push towards circularity because of its focus in the cluster. The close collaboration between research institutions and industry in Norway, also creates a space in which companies can be inspired by ongoing research. In NCP's case, promising studies on the use of plastic waste from the Norwegian coastline and aquaculture industries, struck a chord on the possibilities for its furniture production. On the market side, however, meeting the needs of customers at a price they are willing to pay, necessitates the product line to continue to include both environmental and traditional products.

NCP's recognition of the importance of sustainability represents its normative commitment. Normative influences for sustainability include its long-term outlook and recognition that the acceptability of plastic products is changing in both the institutional and individual levels of society. Such helped NCP redefine its strategy to include both financial viability and sustainability objectives, and the goal to have a fully circular product line by 2030. Further, the organization's identity as a local furniture designer and manufacturer influences its avoidance of potential price saving mechanisms such as relocating production. Using waste from local fish farms also supplements aspects of its normative identity of locality. While market and customer readiness have not yet fully returned the investment on its normative ideals, NCP continues its journey and commitment to sustainability innovation.

In terms of mimetic drivers for sustainability, seeing the potential of waste plastics for input to similar production processes, inspired NCP to jump on the possibility of being a first mover in the furniture space. The potential for resulting competitive advantage helps to close the gap between its market and sustainability logics.

NCP's sustainability journey has been influenced by these institutional mechanisms, summarized in Table 2. Cases when aspects of both its market and sustainability logics are supported pose attractive areas for further innovation or product line development. Funding from a government organization supported the R&D and partial purchase of the manufacturing equipment needed for the environmental line of products, signaling Norwegian society's recognition of the value in such production. However, when introduced to the local market, the higher price of the environmental line, meant that NCP often lost out on potential contracts

with its public customers. While in theory the chairs from recycled plastics were attractive for indicating the sustainability commitment of customers, factors of the market have ultimately been the deciding factor. Coercive mechanisms from the state, such as environmental requirements for public procurement, could therefore help companies like NCP get a higher return on their sustainability investment and better institutionalize the value of sustainability in Norwegian society.

Table 2: NCP summary

Institutional logics	• Market: Customers and profit • Long-term sustainability
Addressing tensions between logics	• Need supportive market mechanisms, e.g., public procurement requirements or purchase incentives
Coercive influences	• Circular economy push from government, state innovation organizations, and cluster organizations • Customer willingness to pay (or not)
Normative influences	• Recognition of value in being a sustainable company for long-term success • Desire to be first mover within furniture • Goal for all products to be circular by 2030 • Local production
Mimetic influences	• Saw potential for recycled plastics as input (previous studies from research institutions)

3.2 Solar Green Energy Cambodia (SOGE)

As a result of national economic growth, Cambodia's energy demand has increased 10% per year since 2010 (Solar Green Energy Cambodia, 2019). Solar Green Energy (Cambodia), known as SOGE, is a renewable energy company (focusing mainly on solar) that provides products and services to meet the gap between electricity demand and availability in Cambodia. SOGE was established in 2013 and stemmed from a renewable energy association founded in 2008. Recognizing the impacts of unreliable access to electricity in rural areas (17% of households lack access to the grid), SOGE works to provide high-quality, locally designed and manufactured, and tailormade solutions for rural households and farmers. Farmers are then able to increase their profit margins and move away from older, inefficient, and environmentally harmful power sources, such as generators, for irrigation. SOGE's affordable, environmentally friendly, and maintained solar and hydro systems also help to reduce farmers' dependence on expensive and difficult to maintain off-the-rack energy systems. SOGE has 21 employees and an operating revenue (2021) of USD359,000, of which USD137,000 were grants.

Social and environmental sustainability are built into SOGE's business model, with its main goals of improving livelihoods through renewable energy provision and maintenance. SOGE produces many of its own products through local in-house design, engineering, and manufacturing. Other necessary components are imported. SOGE operates through three arms: B2B and B2C sales (60% of revenue), manufacturing of some products (20% of revenue), and as a water supplier for large scale irrigation (20% of revenue) (Solar Green Energy Cambodia, 2022a). SOGE's activities surround installation and maintenance of solar systems (off- and on-grid, and hybrid), solar water pumps, solar mini grids, mini hydropower systems, and solar smart irrigation systems (Solar Green Energy Cambodia 2022b). To make its products and services most accessible, SOGE has three payment systems: cash (55% of customers), credit (40% of customers), and rental through the purchase of energy rather than equipment (5% of customers). While SOGE has a few competitors, it is the only one that manufactures locally and offers a four-year warranty on its systems (Solar Green Energy Cambodia, 2022a).

3.2.1 Institutional influences for sustainability

Unlike NCP, an older and more traditional manufacturing company, SOGE has had sustainability incorporated in its organization since the start. Initially funded by NGOs, SOGE is now looking for venture capital to shift the organization to a more commercial enterprise. Driven by a sustainability logic at its core, SOGE therefore faces different tensions than experienced by NCP, as it must continue to find ways to incorporate aspects of a market logic into its identity as a social and environmental sustainability catalyst.

SOGE's sustainability logic is influenced by the impacts of Cambodia's rapid economic growth and development. City and market infrastructures have been developed and the poverty rate is declining (Myrene, 2022). Still, however, a traditionally agrarian and hierarchical society faces challenges related to increasing education, providing jobs for its young population, closing wealth gaps, and developing rural areas. As seen in other countries, this rapid economic growth has resulted in negative impact on the environment including degradation of natural resources, biodiversity loss, air pollution, unmanaged waste, and energy shortages (Myrene, 2022). SOGE has developed its organization in response to coercive, normative, and mimetic influences for sustainability in this institutional context.

Coercive influences are related to the current development gaps in the transition from low-income to high-income economy. Rural populations experience insufficient access to reliable

electricity to support their livelihoods. Recognizing this gap, SOGE was driven to devise an accessible solution to reliable and renewable energy production that curbs the negative impacts of more expensive and damaging energy sources. In this case, state institutions have not adequately supported the needs of the individual level, necessitating that organizations fill the gap.

SOGE's mission is based heavily in normative influences, and its commitment to improve the livelihoods of rural Cambodians. Its normative responsibility for sustainability is reflected in its recognition of the interconnections between social and environmental impacts, energy access, irrigation, and increases in farm yields. Indicators of its impact include: 3641 families provided access to clean, renewable, and reliable energy, an increase of 20-50% in family income due to improved access to electricity (reduced expenses and increased crop yield), and up to 50% improved yield and food production (through increases in both yields and accessible growing land) (Solar Green Energy Cambodia, 2022a). Further, SOGE has identified the importance of local production, strong working rights, and continuous education to build an organization with committed and motivated employees. With the vision to become the "number one renewable energy technology company in Cambodia" (Solar Green Energy Cambodia, 2019), there are also clear normative commitments to becoming an economically viable company.

On the level of mimetic influences, SOGE has been guided by supporting the meeting of infrastructure levels of its ASEAN neighbors. While such guides a macro-level mimetic inspiration, influences from competitors create mimetic drivers on the organizational level. In SOGE's case, aspects that its competitors lack and that are important for the reliable and accessible provision of energy have been identified. These are reflected in its inclusion of a four-year warranty and maintenance with all its energy products and systems.

The regulative, normative, and mimetic influences described, and summarized in Table 3, have influenced SOGE's definition of its organizational identity and its development in response to Cambodia's institutional context. Recognizing insufficiencies on the institutional level, such as limited access to the electricity grid, SOGE has become an organization to fill the gap between individual level needs and the expanding economic development of the country. On top of this, it has built a business around renewable energy production, providing accessibility and environmental protection. Multiple payment systems and tailormade solutions show its appreciation of the importance of working within the conditions of its context to support

commercial viability without sacrificing sustainability objectives. As support from NGOs is replaced by venture capital, SOGE will continue to provide an interesting example of how to balance and juggle sustainability and market logics in one organization.

Although not specifically mentioned in the business examples, the growing prevalence of the sustainability agenda on the world-scale, has impacted the logics and strategies of both organizations. Global initiatives such as the SDGs continue to permeate organizations, and while they may only signal symbolic institutional change in some cases, show that our understanding of what is right is shifting to a greater appreciation of the planet and its link to our livelihoods.

Table 3: SOGE summary

Institutional logics	• Livelihood development – energy gap • Customers • Responsibility – life-long learning, honesty, creativity, trust
Addressing tensions between logics	• Multiple payment systems • Adaptable systems
Coercive influences	• Rapid economic growth • Lacking access to reliable electricity and grid
Normative influences	• To better livelihoods of rural Cambodians • Local production
Mimetic influences	• Meeting infrastructure levels of ASEAN neighbors • Lack of maintenance provision by competitors

4 Discussion and conclusion

The contribution of institutional theory to the understanding of organizations is its recognition of the multi-directional relationship between societal actors and institutions. Institutions impose ideas of what is rational on societal actors, while those actors simultaneously are constrained by and enact feedback on those very institutions.

Other studies have situated their research within one organizational field to examine the interactions that lead to sustainability in a specific industry sector (e.g., Escobar and Vredenburg 2011; Glover et al. 2014). These studies provide empirical descriptions of specific contexts to identify past and predict future types of institutional influences for sustainable development. The approach in this paper is instead to illustrate the complex and multilevel contexts in which sustainability management must be studied through the juxtaposition of

diverse examples. It is not intended to suggest one approach, combination of logics, or institutional mechanism over the other, but to demonstrate the extensive and varied impacts of institutions on organizations, and vice versa, in their journey toward sustainability. While standardized and easily applicable approaches toward sustainability management are desired by industry and called for in research, the complex environment in which each organization is situated requires context-specific analysis as well. Guidelines, innovation funds, and practitioner tools must not overlook this essential aspect of sustainability management. They must be able to assist in the identification of symbiotic and discordant interactions within and between societal levels of the institutional context under study.

As the greater institutionalization of sustainability triggers the growing incorporation of a sustainability logic into organizations, managers will need to continue to work to find synergies between potentially conflicting market and sustainability objectives. Institutional leadership, related to the management of institutional values and the identity of an organization (Askeland, 2020; Selznick, 1957), will therefore continue to be important to guide decision-making in contexts of changing and competing institutional logics (Laasch, 2018; Radoynovska et al., 2020).

The two business examples demonstrate different cases of institutional influence and involvement and show how institutional logics guide and are influenced by coercive, normative, and mimetic influences. NCP, a traditional market-driven organization, recognized the opportunity in actively transitioning its material inputs to circular and local sources. Signaled by government funding programs, it invested in new technology to support its circular manufacturing initiative. Making waves in design, removing local plastic fishing waste, and extending its product line, NCP still found that although supported by regulative sources, the market and its customers were not quite ready to commit to circular materials and design over price. SOGE, an NGO funded organization, set out as a new organization with environmental and social sustainability at its core. Identifying gaps in government support for changing livelihoods, it designed a business model to deliver renewable energy to rural populations. Although at different points in their sustainability and corporate journeys, both cases show the influence of local institutional contexts on the suitability of sustainability strategies.

This paper has presented institutional theory as a lens through which to view the process of sustainability management. The development and improvement of sustainability management practices requires that an organization recognize its position in its inter-institutional system.

This positioning exposes the patterns of beliefs and norms that support its license to operate and can help identify areas where changing practices and expectations may occur. As sustainability competes with the market for a larger share of an organization's value logic, tensions between customers and stakeholder needs, financial and non-financial value, and maximum growth and environmental and social stability pose difficult circumstances for organizations. Clear identity, objectives, and management practices will help support an organization in its journey toward greater sustainability.

5 References

Askeland, H. (2020). Institutional Leadership: Maintaining and Developing the 'Good' Organisation. In H. Askeland, G. Espedal, B. Jelstad Løvaas, & S. Sirris (Eds.), *Understanding Values Work: Institutional Perspectives in Organizations and Leadership* (pp. 139–158). Cham: Springer International Publishing. doi: 10.1007/978-3-030-37748-9_8

Baumgartner, R. J., & Ebner, D. (2010). Corporate sustainability strategies: Sustainability profiles and maturity levels. *Sustainable Development*, *18*(2), 76–89. doi: 10.1002/sd.447

DiMaggio, P. J., & Powell, W. W. (1983). The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, *48*(2), 147–160. doi: 10.2307/2095101

Durand, R., & Thornton, P. (2018). Categorizing Institutional Logics, Institutionalizing Categories: A Review of Two Literatures. *Academy of Management Annals*. Retrieved from https://papers.ssrn.com/abstract=3164895

Escobar, L. F., & Vredenburg, H. (2011). Multinational Oil Companies and the Adoption of Sustainable Development: A Resource-Based and Institutional Theory Interpretation of Adoption Heterogeneity. *Journal of Business Ethics*, *98*(1), 39–65. doi: 10.1007/s10551-010-0534-x

Friedland, R., & Alford, R. (1991). *Bringing Society Back In: Symbols, Practices, and Institutional Contradictions*.

Geissdoerfer, M., Vladimirova, D., & Evans, S. (2018). Sustainable business model innovation: A review. *Journal of Cleaner Production*, *198*, 401–416. doi: 10.1016/J.JCLEPRO.2018.06.240

Glover, J. L., Champion, D., Daniels, K. J., & Dainty, A. J. D. (2014). An Institutional Theory perspective on sustainable practices across the dairy supply chain. *International Journal of Production Economics*, *152*, 102–111. doi: 10.1016/j.ijpe.2013.12.027

Greenwood, R., Oliver, C., Suddaby, R., & Sahlin-Andersson, K. (Eds.). (2012). *The SAGE Handbook of Organizational Institutionalism*. London, UNITED KINGDOM: SAGE Publications. Retrieved from http://ebookcentral.proquest.com/lib/ntnu/detail.action?docID=1024020

Greenwood, R., Raynard, M., Kodeih, F., Micelotta, E., & Lounsbury, M. (2011). Institutional Complexity and Organizational Responses. *The Academy of Management Annals*, *5*, 317–371. doi: 10.1080/19416520.2011.590299

Greenwood, R., & Suddaby, R. (2006). Institutional Entrepreneurship in Mature Fields: The Big Five Accounting Firms. *The Academy of Management Journal*, *49*(1), 27–48. doi: 10.2307/20159744

Jennings, P. D., & Zandbergen, P. A. (1995). Ecologically Sustainable Organizations: An Institutional Approach. *The Academy of Management Review*, *20*(4), 1015–1052. doi: 10.2307/258964

Kraatz, M. S., & Block, E. S. (2008). Organizational Implications of Institutional Pluralism. In *The SAGE Handbook of Organizational Institutionalism* (pp. 243–275). London: SAGE Publications Ltd. doi: 10.4135/9781849200387

Laasch, O. (2018). Beyond the purely commercial business model: Organizational value logics and the heterogeneity of sustainability business models. *Long Range Planning*, *51*(1), 158–183. doi: 10.1016/J.LRP.2017.09.002

Landrum, N. E. (2018). Stages of Corporate Sustainability: Integrating the Strong Sustainability Worldview. *Organization & Environment*, *31*(4), 287–313. doi: 10.1177/1086026617717456

Lüdeke-Freund, F. (2020). Sustainable entrepreneurship, innovation, and business models: Integrative framework and propositions for future research. *Business Strategy and the Environment*, *29*(2), 665–681. doi: 10.1002/bse.2396

Meyer, J. W., & Rowan, B. (1977). Institutionalized Organizations: Formal Structure as Myth and Ceremony. *American Journal of Sociology*, *83*(2), 340–363.

Meyer, J. W., & Rowan, B. (1983). The structure of educational organizations. In J. W. Meyer & W. R. Scott (Eds.), *Organizational Environments: Ritual and Rationality*. Beverly Hills: SAGE Publications.

Meyer, J. W., & Scott, W. R. (1983). *Organizational Environments: Ritual and Rationality*. SAGE Publications.

Myrene, K. L. (2022). *Cambodia Background Analysis*. Norwegian Mission Alliance.

Phillips, N., & Malhotra, N. (2012). Taking Social Construction Seriously: Extending the Discursive Approach in Institutional Theory. In R. Greenwood, C. Oliver, R. Suddaby, & K. Sahlin-Andersson (Eds.), *The SAGE Handbook of Organizational Institutionalism*. London, UNITED KINGDOM: SAGE Publications. Retrieved from http://ebookcentral.proquest.com/lib/ntnu/detail.action?docID=1024020

proff.no. (n.d.). Nordic Comfort Products AS - Hemnesberget—Regnskap. Retrieved March 25, 2022, from https://www.proff.no/regnskap/nordic-comfort-products-as/hemnesberget/m%C3%B8bler/IF43876015G/

Radoynovska, N., Ocasio, W., & Laasch, O. (2020). The emerging logic of responsible management: Institutional pluralism, leadership, and strategizing. *Research Handbook of Responsible Management*. Retrieved from https://www.elgaronline.com/view/edcoll/9781788971959/9781788971959.00037.xml

Schaltegger, S. (2013). Sustainability Management. In S. O. Idowu, N. Capaldi, L. Zu, & A. D. Gupta (Eds.), *Encyclopedia of Corporate Social Responsibility* (pp. 2384–2388). Berlin, Heidelberg: Springer. doi: 10.1007/978-3-642-28036-8_741

Scott, W. R. (1983). The organization of environments: Network, cultural and historical elements. In J. W. Meyer & W. R. Scott (Eds.), *Organizational Environments: Ritual and Rationality*. Beverly Hills: SAGE Publications.

Scott, W. R. (1995). *Institutions and Organizations: Ideas and Interests* (1st ed.). Los Angeles, CA: SAGE Publications.

Scott, W. R. (2001). *Institutions and Organizations: Ideas and Interests* (2nd ed.). Los Angeles, CA: SAGE Publications.

Scott, W. R. (2005). Institutional Theory: Contributing to a Theoretical Research Program. In K. G. Smith & M. A. Hitt (Eds.), *Great Minds in Management: The Process of Theory Development*. Oxford, UK: Oxford University Press.

Selznick, P. (1957). *Leadership in Administration*.

Skjæran, H.-P. (2021a, March 2). *Sustainability at Nordic Comfort Products* (H. Knudson, Interviewer) [Online].

Skjæran, H.-P. (2021b, April 8). *Sustainability at Nordic Comfort Products 2* (H. Knudson, Interviewer) [Online].

Solar Green Energy Cambodia. (2019). ABOUT US. Retrieved March 31, 2022, from Www.solarcambodia.com website: http://www.solarcambodia.com/en/about-us

Solar Green Energy Cambodia. (2022a). *SOGE Business Plan*. Solar Green Energy Cambodia.

Solar Green Energy Cambodia. (2022b). *SOGE Company Profile*. Solar Green Energy Cambodia.

Thornton, P. H. (2004). *Markets From Culture: Institutional Logics and Organizational Decisions in Higher Education Publishing*. Stanford University Press. doi: 10.1515/9781503619098

Thornton, P. H., & Ocasio, W. (1999). Institutional Logics and the Historical Contingency of Power in Organizations: Executive Succession in the Higher Education Publishing Industry, 1958– 1990. *American Journal of Sociology*, *105*(3), 801–843. doi: 10.1086/210361

Thornton, P. H., & Ocasio, W. (2012). Institutional Logics. In R. Greenwood, C. Oliver, R. Suddaby, & K. Sahlin-Andersson (Eds.), *The SAGE Handbook of Organizational Institutionalism* (pp. 99–129). London: SAGE Publications Ltd. doi: 10.4135/9781849200387

Tolbert, P. S., & Zucker, L. G. (1983). Institutional sources of change in the formal structure of organizations: The diffusion of civil service reform, 1880-1935. *Administrative Science Quarterly*, 22–39.

Zucker, L. G. (1983). Organizations as institutions. In *Research in the Sociology of Organizations* (Vol. 2, pp. 1–47). JAI Press Inc.

Zucker, L. G. (1987). Institutional Theories of Organization. *Annual Review of Sociology*, *13*(1), 443–464. doi: 10.1146/annurev.so.13.080187.002303

ISBN 978-82-326-7384-1 (printed ver.)
ISBN 978-82-326-7383-4 (electronic ver.)
ISSN 1503-8181 (printed ver.)
ISSN 2703-8084 (online ver.)

NTNU

Norwegian University of
Science and Technology