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Conceptualizing Business Model Evolution

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Preface

With finishing this thesis, an exiting chapter comes to an end. I had the chance to work with outstanding academic scholars and practitioners that have influenced my work and me personally. As there are certainly too many people to highlight here, I will try to mention a few.

This thesis would not have been possible without the unwavering support of my PhD advisor Prof. Dr. Helmut Krcmar. I am grateful for your guidance and mentorship within this thesis and also for collaborations on research projects. Discussions with you and how you look at challenges have inspired me.

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Munich, September 2022 Norman Schaffer

Abstract

Problem Statement: Changing market dynamics and faster technological innovation create the need for organizations to quickly and continuously innovate their business models to remain competitive. However, many business model innovation activities fail, and innovating a business model once is not sufficient. Organizations must be able to innovate their business models repetitively. Hence, managers need to understand how business models evolve. The extant literature on business model evolution is fragmented and does not manage to contextualize the phenomena. How business model evolution unfolds, which mechanisms are in place, and antecedents and outcomes to the process are not understood. Research further proposed using software-based tools to manage the evolution of business models and capture the inherent complexity in a business model. However, interrelations within business models that compose virtuous and vicious cycles in a business model are not well understood and the potential benefits of business model tools, such as simulation, are not fully leveraged. Practitioners fail to repetitively innovate and evolve their business models. They are missing an understanding of how business models evolve, what mechanisms are in place and how to steer that process to reach their goals.

Research Design: To fill this gap, we review the literature on business model dynamics and business model evolution. We then analyze and structure interrelations between components of a business model. Further, we conduct three longitudinal case studies to contextualize business model evolution. We additionally gather and structure requirements and design principles toward business model tools. In a final step, we follow the design science research strategy to develop a software-based business model tool prototype.

Results: We first structured literature on business model dynamics. Second, we classified interrelations between business model components. Third, we developed a model of business model evolution and conceptualized it as a process. Fourth, we present antecedents and outcomes to the process. Fifth, we identified mechanisms of business model evolution and specific routines that can manifest dynamic capabilities. Sixth, we provide an exhaustive overview of requirements and design principles for business model tools. Seventh, we developed a tool prototype to model and simulate the evolution of business models. Thus, results cover various supporting facets of business model evolution.

Contributions: The results of this thesis mainly contribute to the business model and information systems literature. The model of business model evolution developed within this thesis adds to our understanding of business models, its formalization and conceptualization as a theoretic construct, and the research stream of business model evolution set within business model innovation. Further, we contribute by showing how advancements in information technology (IT) influence the evolution of business models. We further contribute to the literature on dynamic capabilities, organizational resilience, and platform emergence, bridging these streams with literature on business models. Practical implications include mechanisms of business model evolution, implementable routines to build and manifest dynamic capabilities, and a tool-based simulation approach to evaluate different directions of business model innovation and grasp business model evolution.

Limitations: This research is subject to different limitations. Literature reviews rely on the search process performed by one or few researchers and may not cover all aspects related to a given topic. Qualitative methods dominate our research strategy, particularly case studies based on interviews, and come with limited generalizability. We included as much data as possible to build on rich information for case coding. Interviews can further include a researcher's bias. We countered these limitations with data triangulation and several interview partners. Lastly, the application of design science research also comes with certain limitations, as there is little guidance in the IS community on assessing its contribution.

Future Research: This thesis provides initial steps toward different aspects for future research. First, future research can build on our model of business model evolution, further extend and evaluate it and establish it as a profound theoretical construct for research. Second, we provide the groundwork to study different mechanisms, antecedents, and outcomes of business model evolution. Third, we bridged research on business model evolution and dynamic capabilities, organizational resilience, and platform emergence. Future research could determine different concepts and contexts to provide novel insights into the phenomena, e.g., organizational learning theory. Fourth, qualitative and quantitative studies on business model component interrelations can extend the knowledge base and could even build a database, for example, on context-specific vicious and virtuous cycles in business models. Fifth, our contextualization of business model evolution allows dedicated studies to analyze the role of information systems within that process. Sixth, future research can build a repository of purpose-specific requirements and design principles for business model tools. Seventh, technological advancements, especially in machine learning, offer tremendous potential for research on business model tools. Future research can use machine learning and large-scale data sets, either by automatically assessing publicly available data or by building on existing ERP systems of organizations, to create actionable business model tools, incorporating, e.g., live business model views or BMI recommenders.

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List of Abbreviations

AMCIS	*Americas Conference on Information Systems*
BLED	*BLED eConference*
BMI	*Business Model Innovation*
CON	*Conference*
ECIS	*European Conference on Information Systems*
ENTER	*ENTER e-Tourism Conference*
ERP	*Enterprise-Resource-Planning*
IoT	*Internet of Things*
IJIM	*International Journal of Innovation Management*
IS	*Information Systems*
IT	*Information Technology*
JNL	*Journal*
MCIS	*Mediterranean Conference on Information Systems*
P	*Publication*
PACIS	*Pacific Asia Conference on Information Systems*
RQ	*Research Question*

Part A

1 Introduction

1.1 Motivation

Organizations are innovating their business models to cope with changing market dynamics and faster technological innovation (de Reuver et al. 2013; El Sawy and Pereira 2013; Ferreira et al. 2013; Massa and Tucci 2014; Reim et al. 2018; Teece 2017). Today, firms increasingly compete based on business models rather than products or processes (Gassmann et al. 2013).

Business model innovation (BMI) can lead to competitive advantage and positively impacts performance (Chesbrough 2010; Clauß et al. 2019; Demil and Lecocq 2010; Foss and Saebi 2017; Tavassoli and Bengtsson 2018; Wirtz et al. 2015). Companies can rely on BMI to take advantage of new digital technologies and ensure long-term profitability and growth (Chesbrough 2010). However, it is not enough to innovate a business model once, as market conditions and technologies change rapidly (Chesbrough 2010). As companies compete based on business models, and digital business models, in particular, are showing tremendous success, established and new companies must be able to repetitively innovate their business models to gain and maintain a sustainable competitive advantage (Achtenhagen et al. 2013; Casadesus-Masanell and Ricart 2010; Kraus et al. 2017). Managers need to understand how business models evolve.

Technological advances have increased the pressure on this need to engage in business model evolution actively, with the regular introduction of "*truly new business models*" (Teece 2018): digital photography has disrupted business models in companies like Kodak and Fuji (Koen et al. 2011; Komori 2015; Lucas Jr. and Goh 2009). The internet, as another example, led to a disruption of business models by online companies (Cozzolino et al. 2018; Schallmo et al. 2017; Teece 2018; Valter et al. 2018; Wirtz et al. 2010). Influenced by the success of the internet, more and more firms are creating platform-based business models, such as Uber, that effectively outcompete traditional firms (Baden-Fuller and Haefliger 2013; Parker et al. 2016; Rochet and Tirole 2006). While technological advances can spur the development of new business models (Baden-Fuller and Haefliger 2013), technology itself has no inherent value (Chesbrough 2007) but must be integrated into business models to realize its potential (Zott et al. 2011). To realize this potential, managers must understand how to incorporate technology into BMI and the subsequent evolution of their business models (Fichman et al. 2014; Rai and Tang 2014; Veit et al. 2014).

We understand business models as "*the design or architecture of the value creation, delivery, and capture mechanisms [a firm] employs*" (Teece 2010). We see business model innovations as "*designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements*" (Foss and Saebi 2017). In turn, business model evolution is a process of not one-time but repetitive BMIs that spans over time.

While researchers have elaborated on the benefits of BMI, and models exist addressing BMI (e.g., de Reuver et al. 2013; DiBella 2020; Ghezzi and Cavallo 2020; Laukkanen and Patala 2014; Remane et al. 2017), many BMI initiatives are still unsuccessful (Christensen et al. 2016; Sosna et al. 2010). It is challenging for companies to innovate a business model once

(Christensen et al. 2016; Johnson et al. 2008; Sosna et al. 2010). However, it is an even more significant hurdle for companies to renew business models repeatedly to gain and maintain a competitive advantage. Managers are not able to understand the big picture of how business models evolve. They cannot understand the dependencies between different BMIs over time and the interrelations between components of a business model when innovating it. For example, when an organization introduces a subscription-based revenue model, it must adapt its revenue model, but also the service offering and marketing itself, as new resources and channels are needed. This innovation in one component thus leads to impending or necessary adjustments in other components of the same business model, triggering a process of evolution. In addition, this change will affect future BMIs, as it is challenging to convince customers to return to an old model. Technology is further accelerating the need for innovation, e.g., in the case of the Internet-of-Things (IoT). Existing models and methods in this regard do not provide systematic guidance (Laudien and Daxböck 2016).

To address this complexity and guide BMI and subsequent business model evolution, researchers have recommended using business model tools for practitioners (Augenstein 2019; Remane et al. 2017; Schneider and Spieth 2013; Schoormann et al. 2018; Szopinski et al. 2019; Teece 2010; Zott and Amit 2010). Software-based tools offer great potential for BMI (Ebel et al. 2016; Osterwalder and Pigneur 2013; Szopinski et al. 2019; Veit et al. 2014). Corresponding tools can support the modeling and analysis of business models necessary for innovation using rich data and computational power (Osterwalder and Pigneur 2013; Szopinski et al. 2019). Numerous contributions have called for further advancement of the topic (Ebel et al. 2016; Szopinski et al. 2019; Veit et al. 2014), and it has even been suggested to explore "[…] *the application of computer-aided design tools to design tasks such as prototyping, simulating, iterating and versioning business models* […]" (Osterwalder and Pigneur 2013). However, the inflexibility of most BMI concepts and tools presented in the literature limits their application. For example, they allow analyzing and representing the current state of a company's business model but do not consider the evolution or future state of a particular business model (Augenstein 2019). Managers need the support of software-based artifacts for continuous decision-making by evaluating available BMI options (Augenstein 2019; Moellers et al. 2019; Schaffer et al. 2019).

In research, BMI, business model evolution, and business model tooling have received increasing attention (Foss and Saebi 2017; Massa et al. 2017; Schneider and Spieth 2013; Zott and Amit 2017). Research on business models has yet to reach a common understanding (Foss and Saebi 2017; Massa et al. 2017; Schneider and Spieth 2013; Zott et al. 2011). Massa et al. (2017) identify three different interpretations: (1) attributes of real firms, (2) cognitive/ linguistic schemas, and (3) formal, conceptual representations. Similarly, Foss and Saebi (2017) identify for uses of BMI: (1) its conceptualization, (2) as an organizational change process, (3) its outcomes, and (4) its implications for organizational performance.

In summary, prior research has established an initial understanding of business models, BMI, and business model evolution. However, we observe current research is missing to address practical problems in the evolution of business models. Many BMI activities fail, particularly in incumbent firms (Christensen et al. 2016). The problem increases when considering the bigger picture, realizing organizations cannot continuously deliver suitable innovations to their

business models, such as Kodak or Fuji. BMI research needs to understand how it unfolds in practice over time as an iterative and continuous process accounting for business model evolution (Chesbrough et al. 2018; Foss and Saebi 2017; Sjödin et al. 2020). Research on BMI needs to study antecedents and outcomes of business model evolution as a continuous process (Chesbrough 2010; Foss and Saebi 2017). Further, firms still rely on experimentation instead of supporting tools, using, for example, software-based and/or simulation-based approaches (Chesbrough and Rosenbloom 2002; McGrath 2010; Sosna et al. 2010). We have observed three remaining gaps in the literature, which we address in this thesis.

First, the **conceptualization of business model evolution remains unclear,** with scholars using various definitions and concepts. This results in, on the one hand, an unclear state of knowledge on the phenomena and, on the other hand, a **missing conceptualization of repetitive BMI as a continuous process spanning over time** and not as a one-time occurrence. We refer to this as **business model evolution** (see, e.g., Demil and Lecocq 2010 and Foss and Saebi 2017), which has been researched from different perspectives and levels of analysis (Bohnsack et al. 2021; Chester et al. 2020; Demil and Lecocq 2010; Saebi 2015), but still, overarching theory-building, including a model of how the process unfolds, is missing. It remains **unclear how organizations evolve their business model and which activities account for their success** (Chesbrough et al. 2018; Foss and Saebi 2017; Sjödin et al. 2020). Research on BMI needs to study business model evolution as a continuous process (Chesbrough 2010; Foss and Saebi 2017; Randhawa et al. 2020).

Second, research lacks insights into **antecedents and outcomes of business model evolution**. While scholars studied preconditions of BMI and outcomes of BMI within specific cases, it lacks a clear overview of these antecedents and outcomes for business model evolution. Further, it is unclear what mechanisms are in place and to which specific outcomes they lead. Research tries to explain long-term competitiveness with other concepts, such as **organizational resilience and dynamic capabilities**. However, how these concepts relate to BMI and business model evolution requires further research (Foss and Saebi 2017; Randhawa et al. 2020; Ricciardi et al. 2016; Teece 2017).

Third, the **potential benefits of business model tools are understudied** (Athanasopoulo et al. 2018b). Numerous contributions have called for further advancement of the topic. The necessary **knowledge about requirements for tools** and concrete **functions that tools should support** misses (Szopinski et al. 2019). Existing concepts and tools suffer from inflexibility, limiting their application. Further, the complex **interrelations within business models are not reflected in current tools**. The **possibility of simulation**, instead of trial-and-error, to assess different BMI options is not fully leveraged yet. Managers need the support of software-based artifacts for decision-making in business model evolution.

1.2 Research Questions

To address the gaps outlined above, this thesis develops an empirical understanding of business model evolution by structuring literature and analyzing the evolution of business models in incumbent firms through real-life case studies. We answer three research questions in this thesis:

RQ1: *What is the state of knowledge regarding dynamic business models?*

This research question builds the theoretical basis for the dissertation and covers two aspects. First, a systematic literature review on dynamic business models provides a comprehensive overview of research streams within the field, sets definitions, and shows existing gaps in research. Second, a systematic literature review focuses on interdependencies between business model components. These interdependencies can lead to internal dynamics within a business model and are necessary to understand the evolution of business models.

RQ2: *How and which aspects of a business model evolve over time?*

In the second research question, we empirically analyze the evolution of business models. We build on several in-depth and longitudinal case studies. The cases cover different domains: the photo industry, medical laboratories, and the enterprise software industry. All cases show an evolution of the business model(s) employed. We identify different mechanisms and the role information systems (IS) play in business model evolution. To contextualize business model evolution, we develop and present a process model. Further, we elaborate on the interrelation of business model evolution with further concepts, such as dynamic capabilities or organizational resilience.

RQ3: *Which requirements need to be met by a tool to support the successful application of dynamic business models?*

The third research question gathers requirements for tool support to manage and simulate business model evolution by practice. Requirements are gathered from literature and enhanced from insights from case studies. Further, a tool prototype is developed to model business models, interdependencies between business model components, and to perform simulations of possible behaviors of these models during their evolution based on a system dynamics approach.

1.3 Structure

This thesis is structured in three parts. Part A introduces the topic by motivating it, setting the research questions, and outlining the thesis structure (Chapter 1). Subsequently, we present and explain the needed constructs for this thesis in the conceptual background (Chapter 2). These are business models, BMI, business model evolution, business model tools, dynamic capabilities, and organizational resilience. Next, we present our research approach, which follows a mixed-methods qualitative research strategy and an interpretivst position (Chapter 3).

In part B, we provide an overview of the seven published papers included in this thesis, which can be found in Appendix A in their original format. The first publication (P1) lays the foundation of this thesis by reviewing and structuring the literature addressing dynamic business models (Chapter 4). The second publication (P2) then analyzes on a more detailed level interrelations between components of business models. It serves as a foundation for studying business model evolution (Chapter 5). Based on that, we performed three case studies to understand business model evolution. Publication three (P3) analyzes the case of the IT organization ServiceNow and its business model evolution over 17 years, revealing four mechanisms of business model evolution towards digital platforms (Chapter 6). The fourth publication (P4) looks

at the case of a medical laboratory and its BMI activities over two decades. The study shows how external threats can speed up the process of business model evolution and how organizational resilience is built by repetitive BMI (Chapter 7). In publication five (P5), we look at german photo company CEWE and analyze the evolution of its business models over 27 years. We derive a process model of business model evolution, elaborating on the relationship between BMI and dynamic capabilities (Chapter 8). The sixth publication (P6) gathers and structures requirements and design principles of business model tools and serves as a foundation to develop a tool prototype (Chapter 9). Finally, publication seven (P7) is a design-science research study explaining how we develop a tool prototype to simulate the evolution of business models based on the requirements from P6, and shows an instantiation of the prototype (Chapter 10).

Part C first summarizes the findings of the included papers (Chapter 11). Second, we discuss the results in front of the literature (Chapter 12). Third, we show the limitations of this thesis (Chapter 13). Fourth, we summarize the contribution to theory and the implications for practice (Chapter 14). Fifth, we outline aspects of future research (Chapter 15). Finally, we briefly conclude the thesis (Chapter 16). Figure 1 summarizes the structure of this thesis.

Part A	**Introduction, Conceptual Background, and Research Agenda**			
Part B	**Published Articles**			
	RQ1 What is the state of knowledge regarding dynamic business models?			
	P1	*Dynamic Business Models: A Comprehensive Classification of Literature* Method: Literature Review		
	P2	*An Analysis of Business Model Component Interrelations* Method: Literature Review		
	RQ2 How and which aspects of a business model evolve over time?			
	P3	*From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow* Method: Longitudinal, single case study	**P5**	*Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE* Method: Longitudinal, single case study
	P4	*How Business Model Innovation fosters Organizational Resilience during COVID-19* Method: Longitudinal, single case study		
	RQ3 Which requirements need to be met by a tool to support the successful application of dynamic business models?			
	P6	*Requirements and Design Principles for Business Model Tools* Method: Literature Review		
	P7	*A Tool to Model and Simulate Dynamic Business Models* Method: Design Science		
Part C	**Summary of Results, Discussion, Limitations, Implications, Future Research, and Conclusion**			

Figure 1. Structure of the Thesis

The following paragraphs and Table 1 summarize the seven publications that are part of this thesis (see Part B and Appendix A). We outline each paper's motivation, aim, method, and main contributions.

P1: Dynamic Business Models: A Comprehensive Classification of Literature (Schaffer et al. 2019). This publication addresses the problem of various unstructured literature on business

model dynamics with a high diversity of conceptualizations, definitions, and overlaps. In the paper, we perform a structured literature review to structure different conceptualizations of business model dynamics. We provide an overview of the various definitions and conceptualizations used on the topic and elaborate on a more precise definition. By classifying existing literature, we shed light on the foci of the different dimensions. Based on this, we present four key research topics: The process of business model evolution, independencies within business models, simulation models for business model dynamics, and tool support for the development and management of business model dynamics

P2: An Analysis of Business Model Component Interrelations (Schaffer et al. 2020a). This paper addresses the missing overview of interrelations between business model components identified in P1. When adapting a business model, it is central to understand existing interrelations between components, as a change in a single component can lead to various changes in other components. We gather, describe, and classify these interrelations between business model components based on existing literature. Research can use the insights to model inherent dynamics, for example, during the evolution of business models. In practice, the interrelations support developing and maintaining stable business models and evaluating possible changes to a business model.

P3: From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow (Schaffer et al. 2021c). In this study, we perform a single longitudinal case study on the IT organization ServiceNow to study business model evolution over 17 years. Within the paper, we derive four distinct mechanisms of business model evolution. These mechanisms compromise continuous value proposition extension and enablement of value co-creation during the evolution of business models towards platforms. For research, we provide insights into the evolution towards platform business models and complement the existing perspective of platform emergence with a nuanced business model view. For practice, we show how an existing, IT-based business model can be developed into a platform business model.

P4: How Business Model Innovation fosters Organizational Resilience during COVID-19 (Schaffer et al. 2021b). This publication is the second single longitudinal case study within this dissertation. We study a medical laboratory and its BMI activities over two decades. During the case study, the COVID-19 pandemic started, providing additional insights into the phenomena of business model evolution and the impact of crises on business models. Our study showcases how repetitive BMI can build organizational resilience and how digital innovations can support overcoming threats. For research, we show how continuous BMI can support the development of organizational resilience. For practice, we elaborate on how long-term drivers affect a business model and its evolution and how organizations can build up and use organizational resilience.

P5: Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE (Schaffer et al. 2022). This research represents the third longitudinal case study of this dissertation. We study the case of German photo company CEWE over the course of 27 years, analyzing how the organization's business model evolves. We derive a process model on business model evolution, which incorporates cycles of different types of BMI and the development and utilization of dynamic capabilities. We further show specific dynamic capabilities associ-

ated with this process and routines to manifest them. For research, we show how dynamic capabilities and business model evolution enable and build on each other, especially for technology-enabled BMI. For practice, we identify dynamic capabilities that BMI can build or utilize.

P6: Requirements and Design Principles for Business Model Tools (Schaffer et al. 2020c). In this publication, we gather requirements and design principles for business model tools, a gap identified in P1. We perform a structured literature review to derive various requirements and structure them within five core functions of software tools for business models. For research and practice, we provide a foundation to develop tools and showcase necessary functions and possible design options to address the requirements. Further, the results can serve as an evaluation framework for intermediate development states of business model tools.

P7: A Tool to Model and Simulate Dynamic Business Models (Schaffer et al. 2020b). In this publication, we address the gaps identified in P1, and use the results of P2 and P6 to develop a software prototype. Following design science research (DSR), we design a business model tool prototype capable of modeling business models and simulating interrelations based on system dynamics. For research, we contribute to the design of novel artifacts for BMI, allowing us to address the complexity inherent in business models. Further, we show software tools can enhance decision support within practical settings, even for complex business model decisions.

RQ	No.	Authors	Title	Outlet	Type
RQ1	P1	Schaffer, Pfaff, Krcmar	Dynamic Business Models: A Comprehensive Classification of Literature	MCIS 2019	CON
	P2	Schaffer, Drieschner, Krcmar	An Analysis of Business Model Component Interrelations	PACIS 2020	CON
RQ2	P3	Schaffer, Ritzenhoff, Engert, Krcmar	From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow	ECIS 2021	CON
	P4	Schaffer, Garoz, Weking	How Business Model Innovation fosters Organizational Resilience during COVID-19	AMCIS 2021	CON
	P5	Schaffer, Weking, Hermes, Hein, Krcmar	Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE	IJIM	JNL
RQ3	P6	Schaffer, Weking, Stähler	Requirements and Design Principles for Business Model Tools	AMCIS 2020	CON
	P7	Schaffer, Engert, Leontjevs, Krcmar	A Tool to Model and Simulate Dynamic Business Models	33rd BLED (2020)	CON

Outlet:
AMCIS: Americas Conference on Information Systems
BLED: BLED eConference
ECIS: European Conference on Information Systems
IJIM: International Journal of Innovation Management
MCIS: Mediterranean Conference on Information Systems
PACIS: Pacific Asia Conference on Information Systems

Type:
CON: Conference
JNL: Journal

Table 1. Embedded Publications

In addition to the seven publications embedded in this dissertation, we conducted further studies that relate indirectly to the research questions above (see Table 2). These articles complement the results of the embedded publications and are led by co-authors. Related to RQ1, we investigated capabilities for AI implementation, which, in some parts, include BMI (Weber et al. 2022).

Related to RQ2, we investigated successful configurations of platform business models and provided a typology of digital platform business models (Böttcher et al. 2022), highly interrelated to our results of P3-P5.

Related to RQ3, we analyzed the European tourism ecosystem. We developed different actor types and structured their value exchanges (Schaffer et al. 2021a). With that, we can understand employed business models and use this ecosystem as a case for evaluation within P7.

While the selected seven publications embedded in this thesis (P1-P7) comprehensively answer the three research questions, these publications supplement our results with additional contexts, lenses, and related research areas or narrowed-down research topics, see Table 2.

RQ	Authors	Title	Outlet	Type
RQ1	Weber, Engert, Schaffer, Hein, Krcmar	Organizational Capabilities for AI Implementation—Coping with Inscrutability and Data Dependency in AI	ISF	JNL
RQ2	Böttcher, Hein, Schaffer, Weking, Krcmar	Business Model Configurations for Digital Platform Success - Towards a Typology of Digital Platform Business Models	ECIS 2022	CON
RQ3	Schaffer, Engert, Sommer, Shokoui, Krcmar	The Digitized Ecosystem of Tourism in Europe: Current Trends and Implications	ENTER 2021	CON

Outlet:
ECIS: European Conference on Information Systems
ENTER ENTER e-Tourism Conference
ISF: Information Systems Frontiers

Type:
CON: Conference
JNL: Journal

Table 2. Additional Publications not Embedded in this Thesis

2 Conceptual Background

In this section, we describe the theoretical foundations for this thesis. We define the concept of business models before we discuss BMI, business model evolution, and business model tools. We further introduce the concepts of dynamic capabilities and organizational resilience and show how these have been applied in business model research.

2.1 Business Models

Business models have gained increasing momentum since the mid-1990 in research and practice (Budler et al. 2021; Wirtz et al. 2015; Zott et al. 2011). Despite the growing attention to business models and BMI in practice and rapidly increasing research on these concepts, scholars do not agree on a commonly used understanding of what a business model is (Budler et al. 2021; Foss and Saebi 2017; Massa et al. 2017; Zott et al. 2011). Several literature reviews show different understandings and research streams of the concept (Foss and Saebi 2017; Massa et al. 2017; Schneider and Spieth 2013; Zott et al. 2011), resulting in different interpretations of the concept of business models (Massa et al. 2017; Wirtz et al. 2015). We first engage with existing conceptualizations and position our research to ensure the required construct validity in business model research (Bagozzi et al. 1991).

Three fundamentally different interpretations exist: business models (1) as an attribute of real firms, (2) as a cognitive/linguistic schema, and (3) as a formal, conceptual representation describing the activities of a firm (Massa et al. 2017). We elaborate on each of the interpretations in the following.

The first interpretation uses the concept to study how business models of real firms work by a composition of variables (Massa et al. 2017). Characteristics are measured and not conceptually proposed. Most studies take an empirical stance, analyzing, for example, business model archetypes (Bohnsack et al. 2014; Bohnsack et al. 2021; Laukkanen and Patala 2014), business model patterns (Abdelkafi et al. 2013; Casadesus-Masanell and Zhu 2010; Remane et al. 2017; Zolnowski et al. 2016), or business model reconfiguration as means to cope with competition (Casadesus-Masanell and Zhu 2010). Scholars following this interpretation define the business model concept as a "*set of activities, as well as the resources and capabilities to perform them – either within the firm, or beyond it through cooperation with partners, suppliers or customers*" (Zott and Amit 2010) or as a "*firm's underlying core logic and strategic choices for creating and capturing value within a value network*" (Shafer et al. 2005).

The second interpretation understands business models as cognitive/linguistic schemas, i.e., narratives (Massa et al. 2017). The central idea of this interpretation is that managers make decisions based on images of a real system (i.e., the business model) but not the real system itself. With that, managers follow their cognitive frames that shape their image of business models, which follow established thinking patterns or a dominant logic held by organizational members. Scholars in this stream focus on questions about how organizational members interpret the business model in organization-level sense-making (Ring and Rands 1989), cognitive antecedents of business model design and innovation (Amit and Zott 2015; Martins et al. 2015),

and how models are created and shared among organizational members (Massa et al. 2017). A comprehensive definition of business models covers "*cognitive structures that consist of concepts and relations among them that organize managerial understandings about the design of activities and exchanges that reflect the critical interdependencies and value creation relations in their firms' exchange networks*" (Martins et al. 2015).

The third interpretation uses business models as formal, conceptual representations (Massa et al. 2017). While in the first two interpretations, business models are often implicit, unspoken, or not detailed, in this interpretation, a formal, explicit, graphic, and symbolic model is written down (Massa et al. 2017). Business models as formal, conceptual models aim to cover tacit knowledge and reduce complexity by abstracting and simplifying, as the essential elements for use by managers are highlighted (Sterman 2000). Examples are the business model canvas (Osterwalder et al. 2005; Osterwalder and Pigneur 2010), and the magic triangle (Gassmann et al. 2013). In information systems, this conceptualization is often used on firm or industry level to describe interdependent activities (Amit and Zott 2001), processes run in an organization (Gordijn and Akkermans 2003), or interdependent choices and their consequences (Casadesus-Masanell and Ricart 2010).

For our research, we adhere to the first interpretation, seeing business models as attributes of real firms. With that, we follow one of the central themes of business model research, using a system-level approach to study how organizations do business (Zott et al. 2011).

Wirtz et al. (2015) stress the heterogeneity of constituting components of business models in different conceptualizations. However, the main components of the widely used business model representations (Teece 2010) and practitioner-oriented approaches, such as the Business Model Canvas (Osterwalder and Pigneur 2010) or the Business Model Navigator (Gassmann et al. 2013), can be aggregated into four distinctive components using different terminology: value proposition, market segments, value creation, and value capture mechanisms (Foss and Saebi 2017; Saebi et al. 2016; Teece 2010; Weking et al. 2020c), see Table 3.

Element	**Constituting Components**
Value proposition	Value proposition, offering, products and services, brand
Market segments	Market segments, customers (B2X)
Value creation	Partners, resources, activities, customer relationships, channels
Value capture	Revenue streams, cost structure, investments, financial viability

Table 3. Business Model Components

While different definitions exist, within this thesis, we follow the seemingly growing consensus (Costa Climent and Haftor 2021; Massa et al. 2017) to understand business models as "*the design or architecture of the value creation, delivery, and capture mechanisms [a firm] employs*" (Teece 2010) and "*how the enterprise creates and delivers value to customers, and then converts payments received to profits*" (Teece 2010).

Next to these three interpretations, scholars use different views on business models over all three interpretations: a static and a dynamic view (Demil and Lecocq 2010; Wirtz et al. 2015). The static view incorporates representations of business models based on components. The dynamic view embraces change and innovation of and in business models. We use the static view within this dissertation to study interrelations between business model components and as a foundation to capture certain business models and different types of BMI within our case studies.

The second, dynamic view, uses "*the concept as a tool to address change and innovation in the organization, or the model itself*" (Demil and Lecocq 2010). This dynamic view aims to understand a firm's activities employed to change between different business models and the mechanisms for value creation and capture (Cavalcante et al. 2011; Demil and Lecocq 2010; Ritter and Lettl 2018; Zott et al. 2011). We use that dynamic view to understand how the components of a business model are innovated between different points in time, how business models evolve, and how tool-based simulation of business models is possible. Indeed, innovation, change, and evolution have become essential research foci on business models (Wirtz et al. 2015).

2.2 Business Model Innovation

More recently, BMI emerged as its own research stream (Foss and Saebi 2017; Schneider and Spieth 2013). BMI is about changes in a business model of a firm. This research stream identifies the business model itself as a possible cause of innovation similar to a product, a process, a service, or an organizational innovation (Foss and Saebi 2017; Zott et al. 2011). Indeed, innovating a business model provides higher value than innovating a product or service (Chesbrough 2007), and competition increasingly moves towards competing with business models. A prominent example is Uber, which offered the same service, i.e., personal transportation, as taxi services, but with an entirely new business model. They quickly conquered the market, and by 2022, various competitors existed, with traditional taxi services having taken on their business model logic as well, though not entirely.

BMI is defined as "*designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements*" (Foss and Saebi 2017). The definition shows that BMI implies a conscious decision, i.e., deliberate decision, to innovate. Deliberate means that a manager or an organization purposefully performs an action, which results in the activity of BMI. Further, "*novel, non-trivial changes*" clarifies that a certain level of novelty is needed for BMI.

To determine if a change is "*novel, non-trivial*", scholars use different conceptualizations. Some researchers understand BMI to take place in one single business model component (Amit and Zott 2012; Bock et al. 2012; Schneider and Spieth 2013). Other scholars stress one or several components need to be changed (Frankenberger et al. 2013; Günzel and Holm 2013; Lindgardt et al. 2009), while further scholars require novel combinations (Velamuri et al. 2013; Yunus et al. 2010).

We follow the distinction of Foss and Saebi (2017). An architectural BMI refers to an adaptive and complex BMI, innovating several business model components simultaneously. A modular BMI refers to evolutionary and focused BMI innovating one or a few business model components. Table 4 summarizes the different definitions used throughout this research.

Business Model	An articulation of how a business creates, delivers, and captures value (Osterwalder and Pigneur 2010; Teece 2017).
Business Model Innovation	"Designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi 2017)
Modular Business Model Innovation	Innovating one or few components of a business model, i.e. evolutionary and focused BMI (Foss and Saebi 2017)
Architectural Business Model Innovation	Changes in the overall business model by innovating several business model components simultaneously, i.e. adaptive and complex BMI (Foss and Saebi 2017)
Business Model Evolution	An ongoing process constituted of various activities to innovate one or several components of a business model repetitively over time (adapted from Demil and Lecocq 2010)

Table 4. Definitions of Business Models and Related Constructs used within this Thesis

BMI in successful firms aims to re-design value creation and redefine value propositions for various stakeholders. Organizations that innovate their business model profit from positive performance (Clauß et al. 2019; Cucculelli and Bettinelli 2015; Tavassoli and Bengtsson 2018; Zhang et al. 2021). However, an organization and its business models must keep up with changing conditions (Ferreira et al. 2013; Massa and Tucci 2014; Reim et al. 2018; Wu and Nguyen 2019). Based on these developments, different research streams on BMI emerged (Foss and Saebi 2017).

The first stream covers the conceptualization of BMI and emphasizes on the phenomenon itself (Amit and Zott 2012; Teece 2010). Research aims to find suitable definitions and dimensions of BMI (Johnson et al. 2008; Markides 2015). Further, scholars propose classifications of different types of BMI (Foss and Saebi 2017).

The second stream analyses BMI as an organizational change process with different framings such as "*learning*", "*reconfiguration*", or "*evolution*" (Berends et al. 2016; Demil and Lecocq 2010; Foss and Saebi 2018; Sosna et al. 2010). This stream implies that a one-time BMI is insufficient to ensure a long-lasting competitive advantage (Randhawa et al. 2020) and studies BMI as an organizational change process. The research stream focuses on stages (de Reuver et al. 2013; Frankenberger et al. 2013), capabilities required to support BMI (Achtenhagen et al. 2013; Demil and Lecocq 2010; Doz and Kosonen 2008; Teece 2017, 2018), the relevance of experimentation and learning (Andries et al. 2013; Cavalcante 2014; Chesbrough and Rosenbloom 2002; Eppler et al. 2011; Günzel and Holm 2013; McGrath 2010; Sosna et al. 2010), and practice-oriented tools for management of BMI (Szopinski et al. 2019). There is an increasing trend of experimentation to address BMI (Chesbrough and Rosenbloom 2002; Massa et al. 2017; Sosna et al. 2010) and to integrate external stakeholders into BMI (Weking et al. 2020a). Researchers within this second stream elaborate on the necessity to adapt and align

value creation and value capture (Foss and Saebi 2018; Ritter and Lettl 2018), as BMI is subject to inertia with time (Foss and Saebi 2017). Based on that, one focus recently emerged within this stream is to study BMI as a continuous process an organization needs to foster (Chesbrough 2010; Linder and Cantrell 2000; Teece 2017), referred to as business model evolution. The evolutionary aspects of business models have been partly studied (Zott et al. 2011) on the industry level (Banda et al. 2018; Bohnsack et al. 2014; Vaccaro and Cohn 2004) and the organizational level (Antero et al. 2013; Davies and Doherty 2019; Demil and Lecocq 2010).

The third, rather descriptive research stream deals with the outcome of BMI, i.e., innovative, new business models and their contextualization. Often, the emergence of new business models in a particular industry is studied as the outcome of BMI, for example, for disruptive technologies (Amshoff et al. 2015), for servitization (Sjödin et al. 2020; Visnjic and van Looy 2013; Weking et al. 2018a), for sustainability (Freudenreich et al. 2019), or for mobility (Abdelkafi et al. 2013). To contextualize outcomes, the alignment of value creation and value capture is used (Sjödin et al. 2020). Further, particular types of new business models are studied without concrete domain focus, e.g., service-based business models (Visnjic and van Looy 2013) or business models for low-income markets (Yunus et al. 2010).

The fourth research stream investigates the organizational performance implications of BMI. Some scholars look at the process of BMI and how certain outcomes are achieved (Aspara et al. 2010; Bock et al. 2012; Cucculelli and Bettinelli 2015; Weking et al. 2019). Compared to the third stream, here, the focus lies on the actual performance outcomes at the firm level and not the outcome of the innovation (i.e., how the new or adapted business model looks like). Further, the performance of different business models is analyzed (Haddad et al. 2020; Malone et al. 2006; Zott and Amit 2007).

This thesis addresses BMI mainly from an organizational change perspective, i.e., the second research stream. While prior research has studied, for example, stages within the process of BMI, it lacks an overview of how business model evolution unfolds and insights into mechanisms, antecedents, and outcomes of this continuous process (Chesbrough 2010; Chesbrough et al. 2018; Foss and Saebi 2017; Sjödin et al. 2020). We will elaborate on the phenomena of business model evolution in section 2.3. Next, we will discuss BMI in relation to digital technology.

Business Model Innovation and Digital Technology

Nowadays, BMI often includes digital technology, for example, when changing a business model from selling a product to offering a service (Sjödin et al. 2020; Velamuri et al. 2013; Visnjic et al. 2017; Visnjic et al. 2021). While the product might remain the same, digital technology might be necessary to offer or monitor the service and enable a different revenue model. In general, digital technology plays a crucial role in business model design and innovation (Costa Climent and Haftor 2021; Fichman et al. 2014; Jin and Robey 2008; Pynnönen et al. 2012; Rachinger et al. 2019; Rai and Tang 2014; Schallmo et al. 2017; Veit et al. 2014; Weking et al. 2020b). As Chesbrough (2007) demonstrated, technology per se has no inherent value. Instead, it needs to be embedded into products, services, and subsequently into business models

to realize a technology's potential (Zott et al. 2011). These technology-enabled business models can be a source of value creation (Rai and Tang 2014). Consequently, an organization's choice towards its business models affects how technology is monetized and thus its profitability (Baden-Fuller and Haefliger 2013).

BMI can be directly based on new technologies and positively influence a firm's competitive advantage (Dymitrowski and Mielcarek 2021). As such, technology can induce BMI, as new organizational structures and business models can be necessary with digital innovation (Hinings et al. 2018). At the same time, BMI can also entail new technologies (Calia et al. 2007; Zott et al. 2011), as organizations risk losing potential uses of their technology when they do not match the current business model (Chesbrough 2010).

This shows a two-sided connection between BMI and technology, which has received little attention (Baden-Fuller and Haefliger 2013). Some scholars try to predict the future use of technology with business model theory (Costa Climent and Haftor 2021), as it has worked priory to explain why some technology-based firms outperform others (Amit and Zott 2001; Sohl et al. 2020; Zott and Amit 2007). While it was shown that technology needs to be embedded into business models (Chesbrough 2007), research lacks insights on how organizations can continuously and repeatedly leverage technology in BMI and how to align technology-driven and technology-induced BMI.

2.3 Business Model Evolution

The phenomenon of business model evolution is set within the literature on BMI. As discussed, it follows the second stream of understanding BMI as an organizational change process (Foss and Saebi 2017). However, while originating from that view, scholars extend their understanding of business model evolution to concepts outside this stream. Recently, business model evolution developed as its own substream within BMI research (Saebi 2015). Wirtz et al. (2015) analyzed the term "*business model*" and its use within the literature to understand if its relevance in research increased. It picked up in the early 2000s and has increased since then. Using the same methodology but extending that view, the term "*business model evolution*" follows a seemingly similar trend, rising in relevance since 2010. Figure 2 shows this development since 2003.

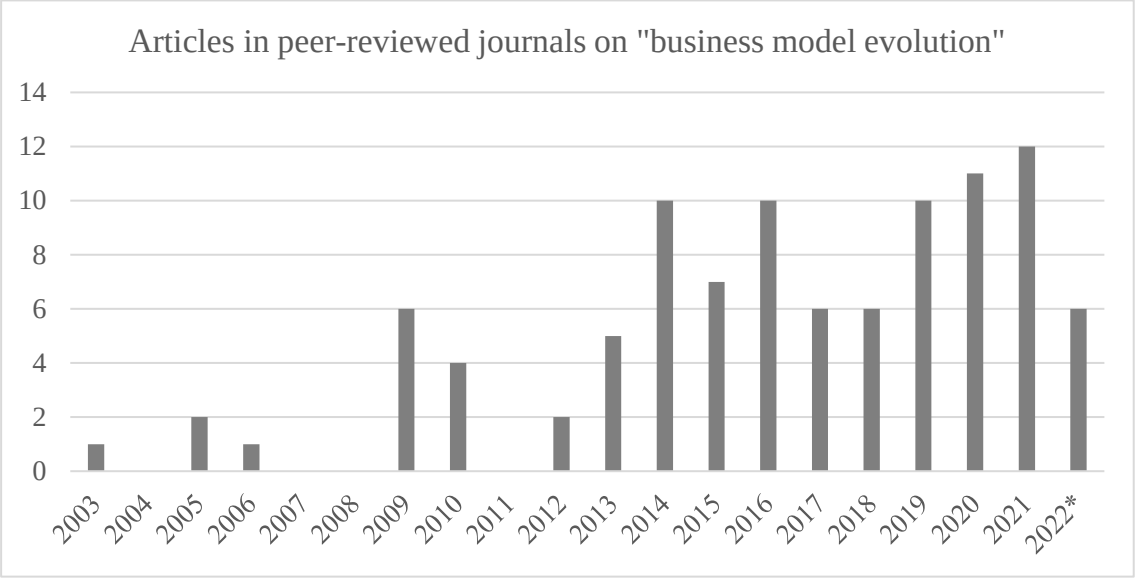

Figure 2. Articles Published in Peer-Reviewed Journals on "business model evolution" Following the Methodology of Wirtz et al., 2015. We used the Databases Scopus and EBSCOhost for Analysis. All Peer-Reviewed Journals are included. The Data Coverage is from 01/2013 until 07/2022. |*data for 2022 is Incomplete and Covers 01-07/2022

While the stream of business model evolution is set within the stream of BMI, it is essential to differentiate both concepts. For business model evolution, as for business models and BMI, various definitions exist. According to the Cambridge dictionary, evolution is "*a gradual process of change and development*"[1]. As such, evolution takes a process view – reflecting the dynamic view of business models – and addresses change and gradual development. With that, business model evolution also considers the factor of time. One of the most cited definitions aligns with these basic assumptions and understands "*business model evolution as a fine-tuning process involving voluntary and emergent changes in and between permanently linked core components*" (Demil and Lecocq 2010). Thus, key differences between business model evolution and BMI is the dimension of time and the assumption of an iterative and continuous process. Business model evolution focuses on a process of change and development over time. As such, business model evolution can include various BMIs over time, see Figure 3. Within this thesis, we understand business model evolution as an ongoing process constituted of various activities to innovate one or several components of a business model repetitively over time

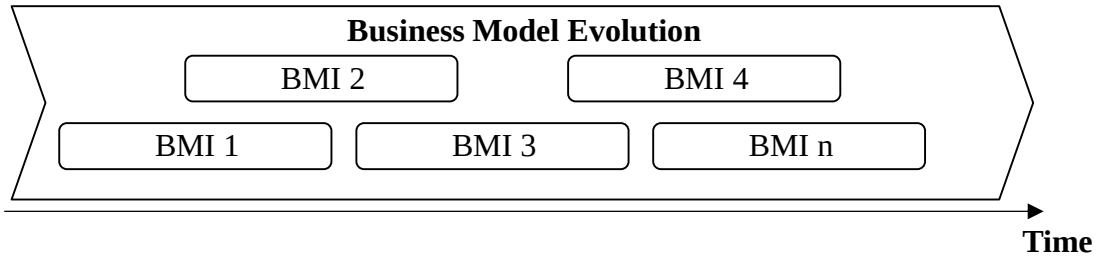

Figure 3. Differentiation of Business Model Innovation and Business Model Evolution

[1] Cambridge Dicitonary. Assessed on 26th July 2022. https://dictionary.cambridge.org/dictionary/english/evolution

Business model evolution has been studied on an organizational level. Antero et al. (2013) explain the need for an evolutionary perspective. The authors examine german software organization SAP and show the need to innovate business models in the ERP sector based on technological advancements, e.g., by developing new partnerships and utilizing new sales channels (Antero et al. 2013). Demil and Lecocq (2010) show that an organization's sustainability depends on anticipating and reacting to voluntary and emerging changes between business model components. The authors use the case of English football club Arsenal FC. They show that external triggers such as the environment influence a business model, require subsequent managerial decisions towards BMI, and can even lead to virtuous and vicious cycles (Demil and Lecocq 2010). Davies and Doherty (2019) elaborate on the challenges of integrating hybrid objectives into value capture during evolution. The ambidexterity to integrate social and environmental values with commercial objectives in the evolution of business models is stressed (Davies and Doherty 2019). Jones and Giordano (2021) analyze a family-owned start-up to understand what role entrepreneurial learning takes in the evolution of business models. Based on a single case, the authors show cognitive learning can positively influence a business model's evolution in terms of organizational growth (Jones and Giordano 2021). Axelson and Bjurström (2019) address the role of timing in the evolution of spin-off business models. They show timing plays a crucial role in introducing a spin-off business model and that aligning to environmental conditions can decrease uncertainty (Axelson and Bjurström 2019). Ahokangas and Atkova (2020) build on complexity theory principles to capture a business model's dynamic interrelations during its evolution. Based on a single case study, the authors demonstrate how a new business model can result from an interplay between business model components. However, they do not elaborate on the actual process or the interrelations in place but rather show the general suitability of complexity theory to study business model evolution (Ahokangas and Atkova 2020). Nailer and Buttriss (2020) use the case of an IT organization to show that business models in a networked environment become mutually connected over time, and evolutionary changes in the practiced business models occur. They show how learning, sensemaking, and adjusting occur during a business model's evolution (Nailer and Buttriss 2020).

Going further as the stream of BMI as an organizational change process, business model evolution has also been studied on an industry level. Bohnsack et al. (2014) look into the evolution of business models in the electric vehicles industry based on business model archetypes. The authors describe the evolution of archetypes over time. They uncover path-dependencies in the evolution of business models when commercializing technology that can lead to self-reinforcing mechanisms (Bohnsack et al. 2014; Bohnsack et al. 2021). These path-dependencies can also stem from the initial tests of business models, which strongly shape the future direction of evolution (McGrath 2010). Balboni et al. (2019) study the evolution of business models from high-tech start-ups. The authors underpin the need to increase a business model's efficiency over time. They further show that business model ambidexterity, as the balance between exploiting an existing business model and innovating or even introducing a new business model, has a positive influence on growth in the long term in the case of start-ups (Balboni et al. 2019). König et al. (2019) also consider start-ups, analyzing the evolution of business models in digital vs. non-digital ventures in early lifecycle stages. Their results suggest digital companies iterate

their business models early during evolution, while non-digital organizations first need financial investments to test a product on the market. Their study shows a positive influence on the success of digital start-ups that seek early transactions with customers (König et al. 2019). Chester et al. (2020) analyze business models in the domain of textile processing and show resilience towards market and technology changes in business models can be increased during their evolution (Chester et al. 2020).

Prior research has studied business model evolution on organizational and industry levels. It showed ambidexterity takes a crucial role and that, especially in technology-driven environments, the evolution of business models requires increased attention by managers. Scholars show that the evolution of business models can be path-dependent and that learning can be crucial in that process. However, research misses elaborating on how business model evolution as a process unfolds, what mechanisms are in place, and which antecedents to this process exist.

2.4 Business Model Tools

Managers use software-based tools to facilitate the process of modeling and BMI to deal with the complexity of business models. Software-based tools are developed using modern IT resources. Several software tools have been proposed to enable the representation and innovation of business models (Szopinski et al. 2019).

The basis of these tools is a defined understanding of what constitutes a business model, i.e., which ontology or representation of a business model is used. The most widely used model is Osterwalder and Pigneur's (2010) Business Model Canvas which has become the quasi-standard for representing business models (Massa et al. 2017). The Business Model Canvas is an ontology for business models and is also presented in the literature as a tool for BMI. Other widely known tools that also are ontologies are the e3-Value ontology (Gordijn and Akkermans 2003), and the St. Gallen Business Model Navigator (Gassmann et al. 2013). Another tool is the Business Model Pattern database (Remane et al. 2017), which provides 182 so-called patterns that describe existing solutions that have proven useful in practice. Research has developed hierarchical taxonomies of these patterns to increase the ease of use for practice (Weking et al. 2018b).

Many existing tools are limited to business model design and visualization (Terrenghi et al. 2017). Individual attempts have also been made to identify the role of IT in other areas and incorporate this into tools, such as business model transformation, evaluation, and management (Augenstein 2019; Rambow-Hoeschele et al. 2019; Terrenghi et al. 2017). Dellermann et al. (2019) develop a decision support system for business model validation. Peinel et al. (2010) describe a modeling approach to support business model planning in the context of eGovernment. In a series of papers, Athanasopoulo et al. developed a tool for business model development in the context of IoT that implements pre-compiled business models using so-called solution-based patterns (Athanasopoulo et al. 2018a; Athanasopoulo et al. 2018b; Athanasopoulou and de Reuver 2018). Groesser and Jovy (2016) provide a quantitative approach for business model analysis, based on a system-dynamics simulation, to address complexity in business models and interactions of company initiatives, business models, and their components.

However, the majority of the existing software-based tools are restricted to visualizing and designing a business model and do not offer simulation capabilities (Terrenghi et al. 2017). To our knowledge, existing tools merely provide the ability to simulate different business model design choices (i.e., scenarios) or depict interdependencies between components to account for inherent dynamics. Further, their use is rather complicated.

Regarding the requirements for software-based business model tools, Szopinski et al. (2019) analyzed 24 programs in practice, providing characteristic functions and comprehensive taxonomy of those tools. Dellermann et al. (2019) developed design principles for decision support systems for business model validation. Ebel et al. (2016) proposed 20 functions to innovate business models. Fritscher and Pigneur (2014) analyzed user adoption of computer-aided business model design features. Yet, no exhaustive overview of requirements for business model tools exists.

One technique proposed in research to model the evolution of business models is simulation. By developing causal loop diagrams, the logical interdependencies in a business model can be captured (Casadesus-Masanell and Ricart 2010), and simulation models can be derived. In the context of business models, on simulation approach proposed is system dynamics (Cosenz and Noto 2018). System dynamics is a computer-aided approach to enhance analysis and decision-making in complex systems (Moellers et al. 2019), and according to Täuscher and Chafac (2016) "*system dynamics focuses on identifying nonlinear causal relations in a system*". It accounts for nonlinearities, delayed cause-and-effect, and feedback relationships (Groesser and Jovy 2016). However, building effective simulation models is complex and requires a deep understanding of simulation approaches. In practice, simulations can be used to evaluate different scenarios of BMI toward a business model's adaptability, profitability, or robustness. Cosenz and Noto (2018) and Moellers et al. (2019) use system dynamics within business model tools to simulate specific KPIs without elaborating on how to build the necessary model for simulation. However, to encourage practical implementation, the ease of use needs to be increased since the simulation outcomes' typical consumers are middle management, innovation managers, entrepreneurs, and potential investors. These consumers are typically only interested in the simulation results and often hesitate to apply resources to design business models required for simulation, limiting the practical applicability of existing tools.

2.5 Dynamic Capabilities

One concept able to explain organizational actions on strategy, business model, and product-level, is dynamic capabilities. While initially based on the resource-based view, dynamic capabilities employ a process approach (Massa et al. 2017; McGrath 2010). The resource-based view postpones a firm's competitive advantage and its long-term performance stems from and is enabled by the resources the firm possesses (Barney 1991). Resources have to be valuable, rare, imitable, and sustainable to support firms to generate sustained competitive advantage (Barney 1991). To capture how to develop, integrate and release these unique resources, Teece et al. (1997) extended this view with dynamic capabilities, defined "*as the firm's ability to*

integrate, build, and reconfigure internal and external competencies to address rapidly-changing environments". So, while the resource-based view emphasizes resource choice, dynamic capabilities emphasize the development, reconfiguration, and renewal of resources to explain an organization's (further) development (Noman and Basiruddin 2021).

Organizational capabilities, in general, describe resources used to produce an outcome and are either inherent in individuals, arise from learning, a combination of organizational assets, and acquisitions (Teece 2016). One can differentiate between ordinary capabilities, which focus on operational and efficiency issues to meet current objectives, and dynamic capabilities. Teece (2016) highlights the difference: "*ordinary capabilities are about doing things right, dynamic capabilities are about doing the right things, at the right time*". Dynamic capabilities refer to a firm's ability to integrate, build, and reconfigure internal competencies to address changes in the business environment (Kump et al. 2018; Teece et al. 1997; Teece 2007). In this thesis, we will focus on dynamic capabilities.

The dynamic capabilities framework differentiates between microfoundations and high-order capabilities. Microfoundations refer to the use and recombination of existing ordinary capabilities and the development of new ones, e.g., new product development and actions that generally support decision-making under uncertainty (Teece 2017). High-order capabilities, in turn, refer to capabilities that enable management to *sense* external developments, e.g., the future use of digital technology (Costa Climent and Haftor 2021), and to *seize* opportunities by adapting organizational structures and business models. Further, *transform* refers to a periodic transformation of aspects of an organization and its culture to address yet newer opportunities and threats (Teece 2016; Teece 2017). When referring to dynamic capabilities, we include microfoundations and high-order capabilities.

Research on dynamic capabilities has taken different streams, elaborating how capabilities manifest themselves in various forms (Eisenhardt and Martin 2000; Helfat and Raubitschek 2018; Schilke et al. 2018; Vial 2019). First, research studies how dynamic capabilities are built and how they are formed by various variables (Zahra et al. 2006). Scholars in this stream employ a perspective of learning and innovation (Helfat and Peteraf 2009; Teece 2007), as dynamic capabilities can be derived from learning processes (Zollo and Winter 2002). Teece indicates a learning process based on detecting threats and opportunities, coordination activities outlining boundaries, decision-making rules, building loyalty, and reconfiguration activities (Teece 2007). This stream traces dynamic capabilities to routines, processes, and collective activities. Routines are repeated patterns of interdependent actions (Feldman and Pentland 2003; Pentland et al. 2012) and support to manifest and further build dynamic capabilities (Helfat and Peteraf 2009). This stream further studies R&D capabilities and the possibility of developing capabilities based on internal R&D processes (Helfat 1997; Kor and Mahoney 2005). Indeed, intensive R&D can lead to increased development of dynamic capabilities (Kor and Mahoney 2005). Further, scholars look at dynamic capabilities related to the position of the firm in the network and its competitive environment. Here, the focus is on alliances and enablers for firms to source knowledge beyond their own boundaries. The learning perspective is extended across organizational boundaries (Rothaermel and Alexandre 2009; Volberda et al. 2010). Expanding the view of the position of the firm in the network, more recently, dynamic

capabilities are used as a lens to study innovation based on platforms (Helfat and Raubitschek 2018; Karimi and Walter 2015; Okano et al. 2022; Shi et al. 2021; Zeng and Mackay 2018). Research also studies how dynamic capabilities can be built within focused niches, e.g., for sustainability (Castiaux 2012).

Second, research studies the utilization of dynamic capabilities. Most scholars within this stream study the alignment of exploration and exploitation (Benner and Tushman 2003; Lubatkin et al. 2006; Raisch et al. 2009), often building on ambidexterity as a focus to study dynamic capabilities (O'Reilly and Tushman 2011). Researchers try to understand how to utilize dynamic capabilities while maintaining a balance of flexibility and efficiency (Eisenhardt et al. 2010), stability and change (Farjoun 2010), and incremental and radical innovation (Tushman et al. 2010). Further, the reconfiguration of capabilities (Xie et al. 2022) is analyzed. Based on this stream, research evolved to understand the utilization of dynamic capabilities and more general innovation strategies as path-dependent, as, next to the position of the network, a dependency on future possibilities exists (Tidd et al. 2006). Research in this stream argues that path dependency can be a property of dynamic capabilities (Vergne and Durand 2011). As dynamic capabilities utilize organizational processes and routines (Helfat and Peteraf 2009; Zollo and Winter 2002), these routines and their manifestation can become path-dependent by the effects of self-reinforcing mechanisms (Vergne and Durand 2011).

Third, scholars look at the outcome of utilizing dynamic capabilities. Typically, the outcomes of utilizing capabilities can be innovation, the maintenance of a competitive advantage, and the ability to respond to threats (Noman and Basiruddin 2021; Randhawa et al. 2020; Teece 2007). Further, capabilities can not only be built by R&D, but also can foster R&D to achieve more radical innovation and to exploit better knowledge stemming from R&D to increase long-term returns of innovation (Denicolai et al. 2016).

Calls have been made to further engage in how dynamic capabilities are developed and leveraged to innovate (Pentland et al. 2012; Schilke et al. 2018; Teece 2007) and further to study the development of dynamic capabilities over time, as this knowledge is valuable, particularly for practice. Currently, the understanding of the design and use of repeatable mechanisms to build dynamic capabilities is limited (Vial 2019). Further, while it is clear that remaining balance plays a crucial role in utilizing dynamic capabilities, it remains unclear how dynamic capabilities can be utilized to achieve certain outcomes and how the capabilities can be manifested. Additionally, the actual outcomes of dynamic capabilities are often generic or unclear. It remains vague how competitive advantage (e.g., higher revenues, better quality, higher market share) is achieved by utilizing dynamic capabilities, how they can be maintained, and how they support responding to threats.

Business Model Innovation and Dynamic Capabilities

Recently, Teece (2017) discussed the relationships between dynamic capabilities and business models. He proposes that business models and dynamic capabilities are interdependent aspects of a firm, but still are interrelated. Foss and Saebi (2017) stress investigating the role of dynamic capabilities as drivers of BMI, and Teece (2017) suggests studying BMI to understand dynamic

capabilities in more detail. Prior research conceptualized dynamic capabilities as a driver of BMI in different forms (Achtenhagen et al. 2013; Heider et al. 2020; Randhawa et al. 2020; Teece 2017). Dynamic capabilities account for an organization's ability to maintain profitability over a longer period, including designing and adjusting business models (Teece 2017). Further, an organization's choices regarding its' business model depend on its' dynamic capabilities (Teece et al. 2016). Organizations with stronger dynamic capabilities have been acknowledged to have more freedom to build business models that entail radical change and to implement effective business models (Teece 2017). Thus, dynamic capabilities are antecedent to BMI and enable it (Achtenhagen et al. 2013; Soluk et al. 2021). Further, the effects of BMI have been described priory to affect dynamic capabilities (Schneider and Spieth 2014). Dynamic capabilities support the scaling of business models (Sandberg and Hultberg 2021), are a key driver to innovating a business model continuously (Ricciardi et al. 2016), and organizations need to develop and maintain them to address change in their business models (Cavalcante 2014).

Additionally, research proposed BMI as a dynamic capability itself (Amit and Zott 2016). On a broader scale, the ability "*to select, adapt, and match the business model and the environment is a capability*" (Teece 2017). Controversy, dynamic capabilities have been described as dependent on the organizational flexibility allowed by business model choices (Teece 2017). This falls in line with the discussion about the changing conception of dynamic capabilities by Peteraf and Haridimos (2017), with organizations' ability to change their resources based on these capabilities. Existing capabilities need to be reconfigured when innovating a business model to address changing conditions (Chesbrough 2010; Randhawa et al. 2020).

While prior research showed dynamic capabilities and BMI are related, it conceptualizes the interrelation differently. Dynamic capabilities account for an organization's long-term profitability, are conceptualized as a key driver for BMI (Ricciardi et al. 2016), and need to be reconfigured when innovating a business model (Randhawa et al. 2020). However, prior research does not manage to explain in detail what role dynamic capabilities take in business model evolution to achieve long-term profitability but rather elaborates on their importance ("*key driver*"). Further, how capabilities can be reconfigured or developed along business model evolution remains unclear and requires further research (Foss and Saebi 2017; Teece 2017).

2.6 Organizational Resilience

Resilience has been an emerging focus in different disciplines, such as ecology, psychology, engineering, management, and information systems (Müller et al. 2013), and has gained momentum during the COVID-19 pandemic. Resilience is the ability to resist and respond to a shock and to recover after a shock has occurred (Annarelli and Nonino 2016; Rose 2004). Taking an organizational perspective, organizational resilience refers to a firm's ability to operate and even thrive through an impairment by adapting quickly and effectively to the situation. Indeed, resilient organizations successfully cope with crises (Suarez and Montes 2020). The concept of resilience is investigated in the context of exogenous shocks, including in recent COVID-19 studies (e.g., Sakurai and Chughtai 2020).

Organizational resilience is a complex construct, which, by definition, is characterized by different elements or attributes. There are various studies on resilience (Annarelli and Nonino

2016; Bhamra et al. 2011; Floetgen et al. 2021; Rose 2004) and the differentiation of its dimensions supports casting light on this complex construct. The dimensions can be roughly differentiated as *resources that enable the development and maintenance of competencies* and *motivation systems and processes that promote effectiveness and growth* (Sutcliffe and Vogus 2003). More detailed, the standard ISO 22316 (ISO 2017) describes nine attributes of organizational resilience. These attributes are reflected in prior related literature (Avery and Bergsteiner 2011; Di Bella 2014; Sutcliffe and Vogus 2003; Weick et al. 1999). Within this dissertation, we use the nine factors to grasp organizational resilience and differentiate them between the two dimensions introduced, see Table 5

Dimensions	**Attributes of organizational resilience**
Resources to develop and maintain competencies	Understanding internal and external context
	Anticipating change and managing necessary adjustments
	Availability of resources to enable adaptation
	Evaluate results and identify opportunities
	Mutual learning
Motivation systems and processes of effectiveness and growth	Coordination of business units to strategic goals
	Shared vision, goals, values, and purpose of the organization
	Effective and encouraging leadership
	Positive cult

Table 5. Dimensions and Attributes of Organizational Resilience (ISO 2017)

When responding to external threats, firms can be backward or forward-oriented. Backward-oriented refers to "*bouncing back*" to a previously existing "*shape*" (Sutcliffe and Vogus 2003) and going back to normal operations of essential structures and functions (Rice and Caniato 2003). Forward-oriented actions, meanwhile, bring renewal beyond mere "*adaptation*" (Hamel and Välikangas 2003). Forward-oriented actions refer to a proactive way of dynamically responding to situations. Examples are transforming (Walker and Salt 2012), developing a new identity (Wastell et al. 2007), or capturing new opportunities (Hamel and Välikangas 2003). This stands in contrast to returning to an original state, which could not cope with the immediate shock in the first place (Sakurai and Chughtai 2020).

Business Model Innovation and Organizational Resilience

Firms can respond to external shocks with BMI. They change their business model to cope with changing circumstances and to allow new ways of value creation, capture, and delivery (Foss and Saebi 2017; Wirtz et al. 2015). As such, BMI plays a role in organizational resilience, as organizational responses lead to changes in the business model. Resilience is even considered a means to cope with a situation and improve the business model (Casalino et al. 2019). The research stream regarding the impact of crises on business models looked at this phenomenon, analyzing the role of business models in the dot-com crash (Magretta 2002; Porter 2001), in

financial crises (Altunbas et al. 2011; Hryckiewicz and Kozłowski 2017), and in natural disasters (Ritchie 2004; Tsai and Chen 2011). More recently, publications concerning the impact of COVID-19 have appeared (Erdelen and Richardson 2021; Gregurec et al. 2021; Seetharaman 2020). Additionally, there have been further calls for papers to understand resilience, e.g., by using information technology (Boh et al. 2020; Sakurai and Chughtai 2020).

However, forward-oriented resilience is understudied, and how BMI fosters resilience is not understood. We look at organizational resilience to understand if and how business model evolution fosters organizational resilience and if it represents a forward orientation, enabling organizations to cope with future crises.

3 Research Approach

To investigate business model evolution, we take on an interpretivist stance and rely on a qualitative strategy of inquiry. In particular, we use literature reviews, qualitative approaches based on empirical and conceptual findings, and case studies, which are qualitative methods and can be used as part of an interpretivist epistemology. We follow the DSR methodology to develop a prototype integrating our findings.

3.1 Interpretivist, Qualitative Research Strategy

The research paradigm is a framework consisting of ontology that defines the nature of reality, an epistemology that defines what can be known about the nature of reality, and methodology, which defines how reality can be analyzed (Denzin and Lincoln 1994). In this dissertation, we adhere to an interpretivist epistemology (Levers 2013). For the methodology, we follow a qualitative research strategy (Gephart 2004).

To improve our understanding of business model evolution, we rely on an **interpretivist** epistemology, as opposed to a positivist, or critical epistemology (Orlikowski and Baroudi 1991). The underlying assumption of interpretivist research is that reality is subjective, i.e., people construct their reality based on their existing knowledge, view, and opinion (Guba and Lincoln 1994). To classify studies as interpretive, Orlikowski and Baroudi (1991) refer to the criteria as "*evidence of a non-deterministic perspective where the intent of the research was to increase understanding of the phenomenon within cultural and contextual situations; where the phenomenon of interest was examined in its natural setting and from the perspective of the participants; and where researchers did not impose their outsiders' a priori understanding on the situation*." Interpretivist approaches aim at investigating interaction among individuals, technologies or organizations (Creswell 2014) and can yield "*deep insights into information systems phenomena including the management of information systems and information systems development*" (Klein and Myers 1999). Consequently, appropriate methods for generating knowledge study phenomena of interest in their natural context and do not require generalizing their findings (Orlikowski and Baroudi 1991). Opposed to an interpretivist epistemology, a positivist epistemology relates to research endeavors that aim at testing theory based on a priori assumptions of researchers, typically formulated as hypotheses (Orlikowski and Baroudi 1991). An interpretivist approach is suitable to study business model evolution as complex interactions between business model components over time occur, which ultimately relate to interactions among organizations, humans, and systems.

We applied a **qualitative strategy** of inquiry for our research. Qualitative research approaches are suitable for studying complex phenomena that often evolve dynamically (Corbin and Strauss 1990). Given the complexity and dynamic emergence, these phenomena are often rare or even unique, making applying quantitative approaches difficult. Qualitative research is often limited to a number of analyzed units and does not aim to fully generalize its' results (Corbin and Strauss 1990). The phenomena under investigation get studied using qualitative data, such as interviews, documents, and participant observations (Myers 1997). The researcher gets in

intense contact with real-life situations and tries to generate an in-depth understanding of how the actors perceive and manage these situations. Sarker et al. (2018) summarize that common qualitative methods cover grounded theory methodology, different types of case studies, and ethnography. We heavily rely on qualitative data, engaging in case studies.

3.2 Research Methods

Following an interpretivist paradigm in combination with a qualitative strategy of inquiry, our main approach is based on case studies (P3, P4, P5, P7). In three studies, we used a systematic literature review (P1, P2, P6) to assimilate knowledge. We followed the DSR methodology in one publication (P7) to create a technical artifact. While each publication includes detailed information about the methodology employed, we provide a brief background on each methodology in this section. Table 6 summarizes which method we applied in the embedded publications.

Publication	Literature Review	Case Study	Design Science
Dynamic Business Models: A Comprehensive Classification of Literature (P1)	X		
An Analysis of Business Model Component Interrelations (P2)	X		
From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow (P3)		X	
How Business Model Innovation fosters Organizational Resilience during COVID-19 (P4)		X	
Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE (P5)		X	
Requirements and Design Principles for Business Model Tools (P6)	X		
A Tool to Model and Simulate Dynamic Business Models (P7)		X	X

Table 6. Research Methods of the Publications

3.2.1 Literature Review

Literature reviews are important to promote and complement existing knowledge (Webster and Watson 2002). Researchers need to find, understand, and synthesize existing research on a topic of interest to provide a foundation for new research projects (Cooper 1988; Vom Brocke et al. 2015). This allows them to derive theories and conceptual contexts for their research and to build on and extend what has already been done (Paré et al. 2015). Additionally, literature reviews reveal research gaps and thus promote the identification of ideas for future research (Paré et al. 2015).

Literature reviews represent a systematic approach to doing this by examining relevant studies and their results that relate to a particular area of interest and the goal of a literature review (Cooper 1988). Literature reviews may focus on research findings, research methods, theories, or applications, while the objectives may be to integrate and synthesize previous work, critique it, or identify key issues (Cooper 1988). The results of a literature review should include a list

of identified literature, a conceptualization of the findings, and a discussion of possible directions for future research (Webster and Watson 2002). Literature reviews are essential to the success of any academic research project (Webster and Watson 2002).

There are different types of reviews: narrative reviews, descriptive reviews, scoping/mapping reviews, meta-analyses, qualitative systematic reviews, umbrella reviews, theoretical reviews, realist reviews, and critical reviews (Paré et al. 2015). Literature reviews also differ in terms of exhaustive, representative, or pivotal coverage of the literature (Cooper 1988). An exhaustive coverage aims to include all publications relevant to the underlying research questions. A representative coverage involves taking a sample that is thought to be typical of a larger group of publications and drawing conclusions for that group from the sample. A pivotal coverage focuses on publications considered central to the topic of interest. In terms of coverage, the study should have comprehensive coverage (Webster and Watson 2002). Most reviews published in the information systems literature are theoretical in nature and have exhaustive coverage. Theoretical reviews aim to build explanations and develop a higher-level theoretical, conceptual structure (Webster and Watson 2002). Therefore, theoretical reviews can generate new theoretical perspectives from existing research.

A theoretical review follows a systematic process of data collection and analysis (Paré et al. 2015). Data collection aims to identify a set of relevant articles in five steps (Vom Brocke et al. 2009). First, authors must identify relevant outlets, i.e., journals and conference proceedings. The second step is to identify relevant databases for the selected outlets. Third, the researchers develop and use a set of keywords to search for articles in the selected databases, which leads to an initial set of potentially relevant articles. The fourth step is a backward and forward search to ensure that the set of articles includes all relevant papers on the topic. In the backward search, researchers examine all references to the identified articles to find other relevant articles. In the forward search, authors review all articles that cite the current set of relevant articles and screen them for additional articles. Fifth, to determine whether or not an article is relevant, researchers evaluate the title in the first round, the abstract in the second round, and the full text in the third round (Vom Brocke et al. 2009). In this way, data collection follows a systematic process. The search for relevant literature is completed when no new arguments, methodologies, results, concepts, or authors relevant to the purpose and objectives can be found (Webster and Watson 2002). Throughout the process, authors should carefully document their research and then specify inclusion and exclusion criteria to select appropriate articles (Okoli and Schabram 2010). Researchers should iteratively refine the relevant inclusion and exclusion criteria (Okoli and Schabram 2010).

After defining the sample population for the literature review, the publications should be structured and analyzed according to the main goal and purpose of the literature review. There are several methods for literature synthesis of theoretical reviews (Paré et al. 2015). Two main approaches are used to structure and analyze a review in the information systems field. First, the author-centric approach provides a list of relevant publications without a corresponding synthesis (Webster and Watson 2002). Second, the concept-centric approach allows to "*assemble the literature being reviewed for a given concept into a whole that exceeds the sum of its*

parts" (Levy and Ellis 2006; Webster and Watson 2002). Webster and Watson propose a concept-centric approach. Here, researchers identify common concepts in a set of articles and construct a concept matrix with concepts on the x-axis and articles on the y-axis. The matrix reveals important concepts addressed in many articles and blind spots or research gaps in the literature. Thus, one of the potential contributions of a structured literature review may be identifying research gaps and developing research agenda (Webster and Watson 2002).

In our study "Dynamic Business Models: A Comprehensive Classification of Literature" (P1), we build on a theoretical literature review to identify and synthesize the main concepts of business model dynamics and carve out future research possibilities. We used the results of this review as a basis for all subsequent research. In the paper "An Analysis of Business Model Component Interrelations" (P2), we performed a theoretical review to identify existing interrelations of business model components, which we used within conducted case studies and in a design science study. We performed another literature review in "Requirements and Design Principles for Business Model Tools" (P6) to gather requirements and possible design principles for tools in the context of business models, which we used to develop a tool prototype.

3.2.2 Case Study

Case studies are the most widely published qualitative method in information systems research and in management and business research (Recker 2013). A case study is "*a contemporary phenomenon (the 'case') in depth and within its real-world context […]*" (Yin 2014). Case studies can thus be used in various ways to describe phenomena, develop theory (Eisenhardt 1989; Eisenhardt and Graebner 2007), and test theory (Benbasat et al. 1987; Darke et al. 1998).

Case studies are intensive studies that investigate a particular phenomenon in the context of a particular time or period and are especially suitable to answer "*how*" and "*why*" questions (Yin 1981, 2018). The phenomenon at hand is mostly contemporary, and the researcher analyses it in its natural setting. The boundary between phenomenon and context can become blurred. Therefore, case studies rely on different data collection methods (e.g., interviews, observation, and secondary data). Different data collection methods are combined to achieve data triangulation (Recker 2013). Yin (2014) proposes six iterative steps to conduct a case study, see Figure 4.

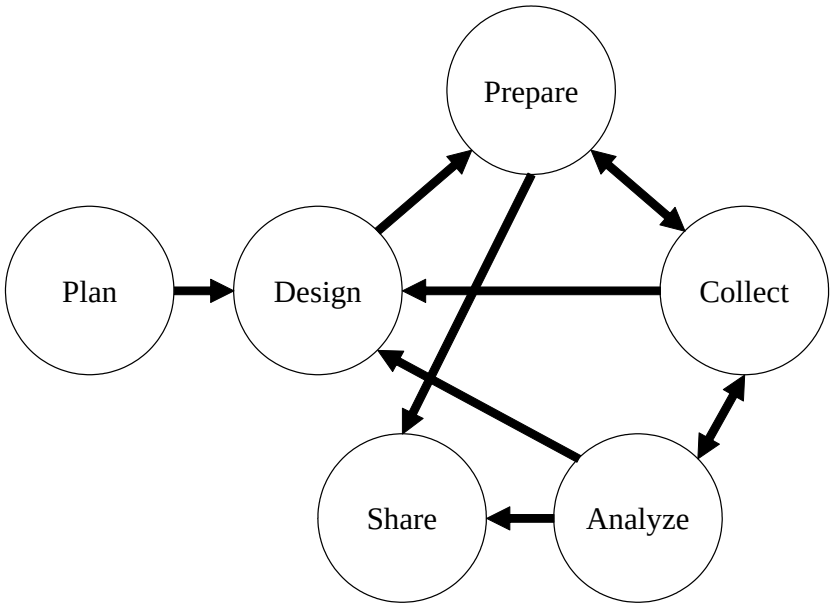

Figure 4. Case Study Procedure (Yin 2014)

Planning involves determining research questions and assessing the appropriateness of a case study approach to explore the questions posed (Yin 2014). Benbasat et al. (1987) provide three guidelines for assessing the appropriateness of case study research. First, it must be determined whether the phenomenon of interest should be observed in a context-dependent setting or whether it can be observed from an external perspective. An example of this would be the introduction of end-user computers, which could only be understood from conversations with people working in companies. Second, because of the interaction between the researcher and the context-dependent phenomenon, the case study method also allows for "*how*" and "*why*" questions, such as how and why companies use end-user computers (Benbasat et al. 1987). Third, case studies are appropriate when the phenomenon of interest is contemporary and little previous research has been done. Researchers need a theoretical understanding of the problem at this stage to identify suitable research questions. In addition, at this stage, researchers must decide whether to develop a theory or test it. In short, the relevant case must encompass a phenomenon that is unique either because of the nature of the case, the historical context, the physical setting, contextual factors such as economic, political, or legal factors, other cases that conflict with the phenomenon, or informants or sources that provide insight into the phenomenon (Stake 1994).

Designing involves defining the research design as a logical plan that leads from research questions to conclusions about those questions (Yin 2014). Research questions and the unit of analysis are set, and the design options for the unit of analysis are evaluated (Yin 2014). Design options are a single unit of analysis, i.e., holistic, or multiple units of analysis, i.e., embedded. The number of case studies determines the difference between a single analysis design and a multiple analysis design. Thus, Yin (2014) defines four types of case studies: single-case holistic, multiple-case holistic, single-case embedded, and multiple-case embedded (see Figure 5).

The design phase also includes the development of a case study protocol that includes, for example, interviews and case databases. In addition, a coding process is described to define the logic that links the data to the propositions.

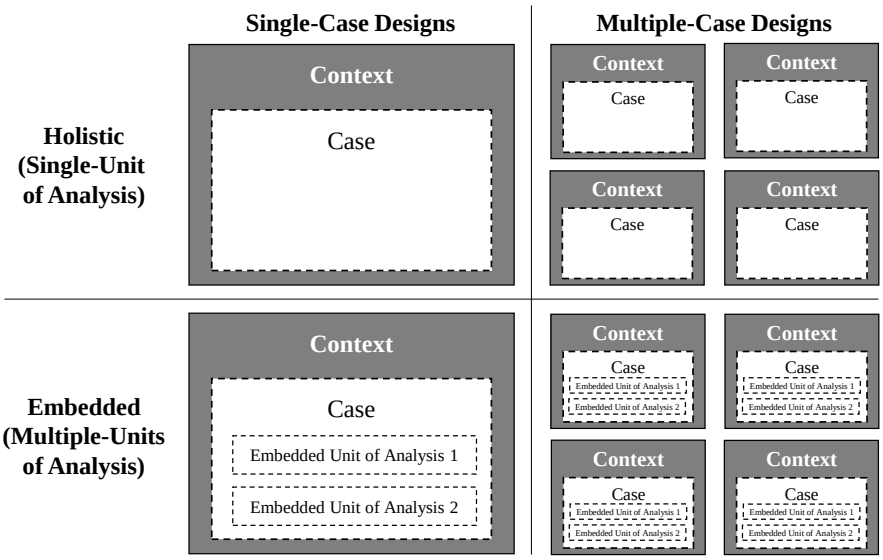

Figure 5. Different Case Study Designs (Yin 2014)

In the **preparation** phase, the main objective is to develop sampling strategies and prepare the data collection process to identify data sources and possible units of analysis that may be latent in the case (Yin 2014). Researchers will hone their data collection skills, including interviews and observations. Case study protocols and guidelines should be refined and tested in advance, e.g., in pilot case studies (Yin 2014). Researchers must also determine which data sources will help solve the research problem. The sampling strategy can be theoretical or selective (Eisenhardt and Graebner 2007). In the case of theoretical sampling, the researcher would iterate on data collection and analysis, then decide in parallel which data source to use to build a theory. In the case of selective sampling, the researcher selects data and cases based on predefined criteria and can develop a theory after collecting and analyzing the data.

Collecting is about implementing a case study protocol (Yin 2014). Researchers need to use multiple data sources to triangulate data and support construct validity. In summary, three types of data are important for qualitative research in general and case study research in particular: interviews (Fontana and Frey 1994), observations (Adler and Adler 1994), and archival data, including internal documents (Hodder 1994). Interviews are the most common method of data collection (Eisenhardt and Graebner 2007). They need to be recorded and transcribed by researchers to create a comprehensive case database. Different data sources need to be triangulated to ensure high validity of research findings(Yin 2014).

Expert interviews are one of the essential tools for collecting qualitative data (Myers and Newman 2007). Expert interviews are studies that reconstruct (social) situations and processes to find or evaluate scientific explanations, aiming to give the researcher access to specific knowledge (Gläser and Laudel 2009; Wiesche et al. 2017). Studies generally distinguish three

types of qualitative interviews. These are structured, unstructured, semi-structured, and group interviews (Myers 2013). Semi-structured interviews are one of the most commonly used types in IS research (Klein and Myers 1999).

Semi-structured interviews do not require a complete interview guide. The researcher may prepare some questions in advance in the form of interview guidelines, but there is also room for improvisation (Bogner et al. 2009; Myers and Newman 2007). Guided interviews include a topic and questions to be answered. Questions are not explicitly formulated or sequenced (Bogner et al. 2009), but arise from the natural flow of conversation during the interview. Ad hoc questions can be used to collect different aspects of the same question (Myers and Newman 2007).

The interview guideline is intended to serve as a reminder for the interviewee to absorb all relevant content. However, the interview guide should not dictate the flow of the interview (Bogner et al. 2009; Myers 2013). Therefore, the interviewer can change the order of the prepared questions. This will allow for a more natural state of discussion. The interviewee should generally not interrupt or imitate the questions (Gläser and Laudel 2009).

The main purpose of **analyzing** is to ensure rigor through construct validity, internal validity, and reliability. Data analysis in a case study involves examining, categorizing, coding, tabulating, testing, or any other combination of data to draw conclusions (Yin 2014). Researchers often rely on qualitative data analysis techniques. Yin (2014) lists four general strategies for data analysis. First, reflect on the theoretical assumptions guiding the research question. Second, engage with the data from "*ground up*" not to make assertions but to "*play with the data*" to gain insights and describe the phenomenon of interest (Yin 2014). Third, case descriptions are developed and organized according to a descriptive framework. Fourth, exploring plausible rivals. The third and fourth strategies can also be seen as complementary and supplementary to the others (Yin 2014). In addition to selecting appropriate strategies, data analysis is necessary to ensure credibility and convince the reader of the internal validity of the case study.

In this context, open, axial, and selective coding (Corbin and Strauss 1990; Glaser and Strauss 2008) of interview transcripts, archival data, internal data sources, and field notes (Strauss 1987) can be performed.

Sharing is the final step and involves identifying target audiences and disseminating the results, usually in the form of a research article or thesis. In addition, this step includes a feedback loop. After the presentation, the audience, the case study participants, and the researcher can reflect on and review the results. The conclusion of the case study is the dissemination of the knowledge gained. The presentation must be tailored to the respective readership. Combining the findings with a rich narrative description of the case study is often helpful so that the reader can better understand the rationale and, if necessary, draw their own conclusions (Yin 2014).

We fully applied the case study approach in our studies "From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow" (P3), "How Business Model Innovation fosters Organizational Resilience during COVID-19" (P4), and "Continuous Business

Model Innovation and Dynamic Capabilities: The Case of CEWE" (P5). The study "A Tool to Model and Simulate Dynamic Business Models" (P7) follows a more confirmatory approach and uses some case study guidelines.

3.2.3 Design Science Research

In DSR, *"the fundamental principle [..] is that knowledge and understanding of a design problem and its solution are acquired in the building and application of an artifact." (Hevner et al. 2010)*. According to this principle, the artifact is central to the DSR paradigm and is both useful and fundamental to acquiring new knowledge and understanding the original problem (Hevner and Chatterjee 2010). The outcome of DSR practice is "*a purposeful IT artifact created to address an important organizational problem*" (Hevner et al. 2004). An artifact can be a decision support system, a modeling tool, a management strategy, an IS assessment method, or an IS change intervention (Gregor and Hevner 2013).

In this thesis, we used DSR in our research titled "A Tool for Dynamic Business Model Modeling and Simulation" (P7), in which we developed a decision support tool based on modeling and simulating business model evolution and inherent dynamics. Therefore, we meet the DSR guidelines for developing an innovative artifact for an unsolved problem, as Hevner et al. (2004) and Gregor and Hevner (2013) suggested. Table 7 summarizes our DSR approach according to the process described by Peffers et al. (2007). This approach involves understanding the context and perceived problem (1), defining (2) and designing (3) a solution, demonstrating the artifact (4), evaluating and testing the artifact with a real use case and interpreting the results (5), and reporting (6) the outcomes. Through this process, we align with previous DSR approaches to business model tooling, such as Athanasopoulo et al. (2018c).

Step	Activities performed within our research
1: Identify Problem & Motivation	Identify the problem and highlight the importance
2: Define Solution Objectives	Selection of requirements to be fulfilled and suitable design principles, based on results from P6
3: Design & Develop	Implement a tool to develop and simulate business model dynamics
4: Demonstration	Apply the artifact to a case study
5: Evaluation	Evaluate a problem-solution fit and determine requirements and improvements for future research
6: Communication	Publish problem and proposed solution to receive feedback from academia

Table 7. Design Science Research Process as Defined by Peffers et al. (2007) and Activities Performed within our Research

To ensure scientific rigor, Hevner et al. (2004) propose seven guidelines for effective DSR in information systems. First, the design must produce a feasible artifact in the form of a model, method or instantiation. Second, DSR should develop a relevant and important technological solution to a specific business problem. Third, the design must be rigorously evaluated in terms of the artifact's utility, quality, and effectiveness. Fourth, DSR should facilitate the development of the knowledge base and the explanation and evaluation of the design artifact. Fifth, DSR should detail the methodology used to create and evaluate the design artifact. Sixth, the design

artifact should be appropriate to the context of the environment. Seventh, the design artifact must be presented effectively to a management and technology-oriented audience. (Hevner et al. 2004)

In the embedded publication “A tool to model and simulate dynamic business models” (P7), we used the DSR methodology as proposed by Peffers et al. (2007) by performing the activities mentioned in Table 7 and adhering to the seven guidelines of effective DSR (Hevner et al. 2004) to develop a tool prototype allowing to model and simulate business model evolution and inherent dynamics.

Part B

4 Dynamic Business Models: A Comprehensive Classification of Literature (P1)

Title	Dynamic Business Models: A Comprehensive Classification of Literature
Authors	Schaffer, Norman* (schaffer@fortiss.org) Pfaff, Matthias* (pfaff@fortiss.org) Krcmar, Helmut[+] (krcmar@in.tum.de) *fortiss GmbH, Guerickestraße 25, 80805 München, Germany [+] Technische Universität München, Chair for Information Systems, Boltzmannstraße 3, 85748 Garching, Germany
Publication	Mediterranean Conference on Information Systems (MCIS), 2019
Status	Published
Contribution of first author	Problem definition, research design, literature search and analysis, interpretation, reporting

Table 8. Fact Sheet Publication P1

Abstract

Business models are vital to companies' success; to stay competitive, companies continuously adapt and innovate their business model. The conceptualisation of business models has received much attention from prior research and the focus of research is shifting from a static perspective to a more dynamic perspective. This research is a comprehensive and up-to-date literature analysis of the concept of dy-namic business models. To achieve a systematic and objective penetration of the research field, we used a classification framework consisting of 15 evaluation dimensions. We identified the main research streams on the topic and present the most relevant approaches, such as system dynamics modelling. A total of 42 relevant literature sources were found. Finally, we highlighted gaps for future research, such as a need for more detailed analyses of the interdependencies between the components a business mod-els consists of.

Keywords: Dynamic Business Model, Literature Review, Innovation, System Dynamics, Interdependencies

5 An Analysis of Business Model Component Interrelations (P2)

Title	An Analysis of Business Model Component Interrelations
Authors	Schaffer, Norman* (schaffer@fortiss.org) Drieschner, Clemens[+] (clemens.drieschner@tum.de) Krcmar, Helmut[+] (helmut.krcmar@tum.de) *fortiss GmbH, Guerickestraße 25, 80805 München, Germany [+] Technische Universität München, Chair for Information Systems, Boltzmannstraße 3, 85748 Garching, Germany
Publication	Pacific Asia Conference on Information Systems (PACIS), 2020
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 9. Fact Sheet Publication P2

Abstract

Innovative business models are crucial for a firm's competitive success. When adapting a business model, it is key to understand existing interrelations between its components, as a change in a single component can lead to various changes in other components. Furthermore, the influence of external triggers on components is crucial to understand the inherent dynamics caused by these interrelations. With this study, we gather, describe, and classify interrelations between business model components based on the existing literature. In research, these results can be used to model the inherent dynamics of business models. In practice, this knowledge helps to develop and maintain a stable business model by considering the found interrelations of its components. Furthermore, it supports the evaluation and implementation of changes in business models. Moreover, we contribute to research on business model innovation, dynamic business models, and cognitive biases in the use of business models.

Keywords: Business Model Innovation, Dynamic, Interrelations, Interdependencies, Decision Support

6 From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow (P3)

Title	From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow
Authors	Schaffer, Norman* (schaffer@fortiss.org) Ritzenhoff, Matthias[+] (matthias.ritzenhoff@tum.de) Engert, Martin[+] (martin.engert@tum.de) Krcmar, Helmut[+] (helmut.krcmar@tum.de) *fortiss GmbH, Guerickestraße 25, 80805 München, Germany [+] Technische Universität München, Chair for Information Systems, Boltzmannstraße 3, 85748 Garching, Germany
Publication	European Conference on Information Systems (ECIS), 2021
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 10. Fact Sheet Publication P3

Abstract

Currently, platform-based business models are most successful regarding revenue growth and market shares. However, the stepwise evolution of organizations' business models towards multi-sided plat-forms is not fully understood. Therefore, we conduct a longitudinal case study on the IT organization ServiceNow. Based on publicly available data, we build on research on business model evolution, plat-form emergence, and platform ecosystems to analyze the evolution of ServiceNow's business model between 2004-2020. We derive four distinct mechanisms comprising continuous value proposition ex-tension and enablement of value co-creation. These are enabled by opening towards partners and itera-tively addressing new customer segments. We contribute to research on business model evolution with insights on the evolution towards platform business models. Besides, we complement the perspective of platform emergence by a nuanced business model view, bridging these two literature streams. Practi-tioners benefit from the mechanisms to guide their business model evolution towards a multi-sided plat-form business model.

Keywords: Business Model Evolution, Multi-sided Platforms, Ecosystem, Value Co-Creation, Case Study

7 How Business Model Innovation fosters Organizational Resilience during COVID-19 (P4)

Title	How Business Model Innovation fosters Organizational Resilience during COVID-19
Authors	Schaffer, Norman* (schaffer@fortiss.org) Garoz Pérez, Patricia[+] (patricia.garoz@tum.de) Weking, Jörg[+] (joerg.weking@tum.de) *fortiss GmbH, Guerickestraße 25, 80805 München, Germany [+] Technische Universität München, Chair for Information Systems, Boltzmannstraße 3, 85748 Garching, Germany
Publication	American Conference on Information Systems (AMCIS), 2021
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 11. Fact Sheet Publication P4

Abstract

The COVID-19 pandemic imposes various challenges on societies as well as on organizations, especially in the medical sector. Organizational resilience is a central ability to strive through these challenges. Business model innovation can be a tool to build organizational resilience. Yet, it is unclear how business model innovation fosters organizational resilience. Therefore, we conduct a longitudinal case study on *Laboratory Inc.*, which adapts to the situation, innovates its business model to allow testing for the virus from home, and transmits results digitally. Our results show how organizational resilience is built by business model innovation. The business model innovations performed are not temporary, but lead to a new status of the organization, preparing it for future crises. At the same time, we demonstrate how digital innovations help to overcome crises and support socio-economic value. Our findings contribute to research on organizational resilience as well as on business models under external threats.

Keywords: Business Model Innovation, Organizational Resilience, Medical Laboratories, COVID-19, external shock

8 Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE (P5)

Title	Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE
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Publication	International Journal of Innovation Management
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 12. Fact Sheet Publication P5

Abstract

Continuously innovating business models is necessary to leverage technological progress but remains a complex challenge for firms. Dynamic capabilities explain how organizations ensure long-term success by continuously transforming. Still, how continuous business model innovation unfolds and how dynamic capabilities might support remains understudied. Therefore, we use a 27-years longitudinal case study of CEWE. CEWE transformed from an analog B2B2C business to a digital B2C and B2B brand in the photo industry. We derive a process model on continuous business model innovation, which explains how modular business model innovation builds dynamic capabilities and how architectural business model innovation utilizes them. We enrich business model innovation and dynamic capabilities research by demonstrating how both enable and build on each other. For practice, we show explicit dynamic capabilities and routines to manifest them that guide firms to successfully navigate their business model innovation journey.

Keywords: business model innovation, dynamic capability, technology-enabled business models, longitudinal case study, process model

9 Requirements and Design Principles for Business Model Tools (P6)

Title	Requirements and Design Principles for Business Model Tools
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Publication	American Conference on Information Systems (AMCIS), 2020
Status	Published
Contribution of first author	Problem definition, research design, data analysis, interpretation, reporting

Table 13. Fact Sheet Publication P6

Abstract

Software tools hold great promise to support the modeling, analyzing, and innovation of business models. Yet, both research and practice lack a clear overview of the requirements and design principles for developing such tools. To tackle this issue, we gather requirements and design principles for business model software tools based on a structured literature review. We cluster the requirements within five core functions of tools and map subsequent design principles. By collecting and synthesizing various requirements and design principles, we provide a foundation for further research on business model software tools. In practice, these results contribute to the development of tools and can serve as an evaluation framework for intermediate development states and existing business model software tools. Future research can employ these results for artifact creation. This research guides the development of business model software tools to support firms in sustaining a competitive advantage.

Keywords: Business Model, Requirements, Tool, Analysis, Simulation

10 A Tool to Model and Simulate Dynamic Business Models (P7)

Title	A Tool to Model and Simulate Dynamic Business Models
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Publication	33rd BLED eConference, 2020
Status	Published
Contribution of first author	Problem definition, research design, data collection and analysis, interpretation, reporting

Table 14. Fact Sheet Publication P7

Abstract

Software tools hold great promise to support the modeling, analyzing, and innovation of business models. Current tools only focus on the design of business models and do not incorporate the complexity of existing interdependencies between business model components. These tools merely allow simulating inherent dynamics within the models or different strategic decision scenarios. In this research, we use design science research to develop a prototype that is capable of modeling and simulating dynamic business models. We use system dynamics as a simulation approach and containers to allow deployment as web applications. This paper represents the first of three design cycles, realizing six out of 59 requirements that are collected from the literature on software tools for business models. We contribute toward the design of novel artifacts for business model innovation as well as their evaluation. Future research can use these results to build tools that consider and address the complexity of business models. Lastly, we present several options for extending the proposed tool in the future.

Keywords: Dynamic Business Model, Tool, Simulation, Design Science, System Dynamics

Part C

11 Summary of Results

To address the three research questions of this thesis, we used seven publications. We summarize the findings of the three research questions in the following by describing how each of the publications addresses a particular issue of a research question. The subsequent section discusses these results.

RQ1: *What is the state of knowledge regarding dynamic business models?*

Dynamic Business Models: A Comprehensive Classification of Literature. Based on a literature review, we identified various definitions used in the context of business model dynamics. These served as a basis to classify existing literature within six dimensions and aggregate existing research to specify how scholars differentiate static and dynamic business model views. The literature review identified existing streams with open research gaps and provided promising ways to tackle these: A missing overview of the actual process of how business model evolution unfolds, which case studies could solve; The need to understand business models as complex systems, and to study the interrelation between components of a business model and the implications of these interrelations for the whole model on a very nuanced level; The possibility to use simulation-based approaches, such as system-dynamics or agent-based modeling, to study reinforcing cycles within business models combined with suitably business model ontologies; and the need for tool support to enable practitioners to manage business models over their lifecycle and support decision-making to reduce experimentation with business models on the market but rather enable digital-enhanced prediction models.

An Analysis of Business Model Component Interrelations. We identified and classified interrelations between business model components based on a literature analysis. We identified many interrelations between value proposition and product and service offering with further business model components. Further, we identified a strong interrelation from the value proposition onto financial components, but no strong relation between the financial components back to the value proposition. We developed models of specific components (funding, organizational structure, value proposition, and product and service offering) to allow practitioners to systematically evaluate the impact of possible changes to their business model. Receiving funding based on a business model can severely impact existing cooperations. The organizational structure is affected by other business model components, but surprisingly only by the resources and activities used, the value proposition itself, and the customers addressed. Between the value proposition and the subsequent services or products offered, different cycles exist that influence the activities, customers, and resources in a strong fashion, which should be the focus of thoughts when adapting, rather than channels, pricing strategies, or the funding (to name a few examples).

RQ2: *How and which aspects of a business model evolve over time?*

From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow. Based on our insights from P1 and P2, we conducted a longitudinal case study on the IT organization ServiceNow. In this publication, we build on research on business model evolution, platform emergence, and platform ecosystems to analyze ServiceNow’s business model

evolution between 2004 and 2020. We derive four distinct mechanisms of business evolution: Continuous value proposition extension, iteratively addressing new customer segments, iteratively opening the value creation logic, and the continuous enforcement of building and extending strategic partnerships. We aggregate the mechanisms in a model of business model evolution towards platforms, showing how a business model evolves from closed to open to multi-sided. We contribute to research on business model evolution with insights on the evolution towards platform business models. Besides, we complement the perspective of platform emergence with a nuanced business model view, bridging these two literature streams.

How Business Model Innovation fosters Organizational Resilience during COVID-19. We performed a second longitudinal case study on a highly digitized medical laboratory, "Laboratory Inc." The case is set around the COVID-19 pandemic, which imposes various challenges on societies and organizations, especially in the medical sector. In this paper, we analyze if and how BMI fosters organizational resilience. The case company adapts to the situation, innovates its business model to allow testing for the virus from home, and transmits results digitally. Our results show how BMI builds organizational resilience. This occurs in two dimensions: First, the development and maintenance of competencies support organizational resilience, and second by motivation systems and processes that promote effectiveness and growth. The study shows how external shocks trigger BMI. In turn, organizational resilience can be built proactively by BMI and put an organization into a "*new normal*", moving beyond previous equilibriums and not falling back to an initial status, as can be the case with organizational resilience.

Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE. We conducted a third longitudinal-case study on german photo company CEWE over 27 years. The organization transformed from an analog B2B2C to a digital B2C and B2B business model and became a widely known brand in the photo industry. We analyze in-depth how the evolution of a business model unfolds and further study the role of dynamic capabilities within that process. We develop a model of business model evolution, incorporating cycles of modular BMI to build and leverage dynamic capabilities and architectural BMI utilizing dynamic capabilities. We show how dynamic capabilities are both antecedent and outcome in business model evolution. Further, we outline actual dynamic capabilities relevant during the evolution of business models. We show how routines manifest these capabilities and explain specific business model-related outcomes when utilizing these capabilities, for example, the alignment of brands and business models.

RQ3: *Which requirements need to be met by a tool to support the successful application of dynamic business models?*

Requirements and Design Principles for Business Model Tools. We first gathered business model tools' requirements and design principles to answer this thesis' third research question. Based on a literature review, we identified 59 requirements and clustered them along five dimensions: modeling support, business model design, business model analysis and evaluation, collaboration, and technical requirements. Subsequently, we mapped design principles for each requirement. Our results serve as a basis for developing and evaluating tools in the business model context. They are the foundation for following the design-science research to create the artifact in P7.

A Tool to Model and Simulate Dynamic Business Models. Based on the requirements and design principles from P6, in this publication, we follow the DSR process to develop a prototype capable of modeling and simulating business model evolution and inherent dynamics. The tool incorporates the interrelations identified in P2, to reflect the complexity of interdependencies between business model components and allow simulating inherent dynamics in business models based on different strategic decision scenarios, which current tools were not able to. We use system dynamics as a simulation approach and containers to allow deployment as web applications. The suitability and usefulness of the tool is shown based on a strategic decision within a research project in Bavarian tourism.

Table 15 gives an overview of the key findings of this thesis.

P	RQ	Findings
P1	RQ1	▪ Scholars use various definitions for business model dynamics and different contextualizations (business model -change, -evolution, -reconfiguration, -dynamics, -adaptation). ▪ The review identified a missing overview of the process of business model evolution, the need for simulation-based tools in general, and actual decision-support for practitioners to support decision-making and to study reinforcing cycles within and of real-world business models.
P2	RQ1	▪ There are many interrelations between the components value propositions and product and service offerings with further business model components. ▪ Strong but one-directional interrelation from the value proposition onto financial components, meaning the financial components barely influence the value proposition of a business model. ▪ Funding received based on business models affects existing cooperations. ▪ Organizational structure is affected by different business model components and needs to be systematically assessed when innovating a business model. ▪ Reinforcing cycles between value proposition and product and service offerings exist that incorporate the activities, customers, and resources, which should be the focus of thought when innovating a business model.
P3	RQ2	▪ The evolution of business models follows an iterative process, in the case of platforms from closed to open to multi-sided. ▪ Four mechanisms of business model evolution were identified: Continuous value proposition extension, iteratively addressing new customer segments, iteratively opening the value creation logic, and the continuous enforcement of building strategic partnerships. ▪ Integration of the views of business model evolution and platform emergence.
P4	RQ2	▪ Organizational resilience is built by BMI and can be developed proactively with it. ▪ Development of organizational resilience with BMI follows two dimensions: Resources to develop and maintain competencies and by motivation systems and processes that promote effectiveness and growth. ▪ External shocks, as the COVID-19 pandemic, can trigger BMI. ▪ BMI paired with organizational resilience can move organizations beyond previous equilibriums, putting them into a "*new normal*" .
P5	RQ2	▪ Presentation of a process model of business model evolution. ▪ The model incorporates different cycles of modular BMI to build and leverage dynamic capabilities, and architectural BMI utilizing dynamic capabilities. ▪ Outlining the interrelation between dynamic capabilities and business model evolution: Dynamic capabilities are both antecedent and outcome of business model evolution. ▪ Identifying specific capabilities in place during business model evolution, e.g., developing separate organizational units and their outcomes, e.g., the alignment of brands and business models. ▪ Showing how and which routines can manifest dynamic capabilities within organizations.
P6	RQ3	▪ Identification of 59 distinct requirements for business model tools from literature. ▪ Five key dimensions to cluster requirements towards business model tools: modeling support, business model design, business model analysis and evaluation, collaboration, and technical requirements. ▪ Proposition of design principles to address all identified requirements. ▪ Basis for development and evaluation of business model tools.
P7	RQ3	▪ Prototype of a business model tool that can model and simulate business model dynamics as well as their evolution. ▪ The tool incorporates the complexity existing in business models by capturing interrelations between components. ▪ Tool to support decision-making based on different strategic scenarios. ▪ Use of system dynamics as simulation engine suitable within the business model context.

Table 15. Overview of Key Results

12 Discussion

Based on the findings of this dissertation, we discuss and describe how we contribute to the literature stream of business models. First, we illustrate how we conceptualize a model of business model evolution and discuss its implications for business model research. Second, we elaborate on the role of dynamic capabilities as antecedent and outcome of business model evolution. Third, we show how organizational resilience can be developed with BMI. In addition, we illustrate how simulation-based business model tools can provide value for research and practice as decision support instruments.

12.1 Conceptualizing business model evolution as a continuous process

This dissertation is set within research on business models. More specifically, we contribute to the literature on BMI and business model evolution (Demil and Lecocq 2010; Foss and Saebi 2017).

First, we conceptualize the phenomena of business model evolution (P1, P3, P4, P5), offering clarity for research. To do so, we develop a process model of business model evolution. It describes how the evolution of a business model unfolds over time. Based on the model, we show mechanisms of business model evolution, as well as its antecedents and outcomes. With that, we follow calls to advance research on BMI and its drivers (Foss and Saebi 2017, 2018). Our results support the view that one-time BMI is insufficient to ensure long-term competitive advantage (Chesbrough 2007; Randhawa et al. 2020) and further show that organizations profit from a positive performance by business model evolution (Clauß et al. 2019; Cucculelli and Bettinelli 2015; Ferreira et al. 2013; Massa and Tucci 2014; Reim et al. 2018; Tavassoli and Bengtsson 2018; Wu and Nguyen 2019). The model and the insights derived within our case studies showcase how organizations can successfully master the ambidexterity challenge of a business model still contributing revenues and profits but adapting it to ensure future effectiveness (Sosna et al. 2010). Especially for technology-intensive industries, we can support that successfully managing this ambidexterity positively influences growth (Balboni et al. 2019). In addition to emergent change during business model evolution (Demil and Lecocq 2010), our model drills down on decisions to be taken by organizations and demonstrates how emergent change is translated to conscious decisions. The environment is an external trigger, which requires active actions of managers towards the business model.

Second, scholars apply different views on business models, i.e., static and dynamic (Demil and Lecocq 2010; Wirtz et al. 2015). This dissertation uses both views (P1, P2, P3, P4, P5, P7). With that, we show that both views are not contradictory but can complement each other. The static view enabled us to capture certain business models at specific time points, explicitly show interrelations between business model components, and analyze a business model. Simultaneously, the dynamic view proved necessary to address the evolution itself, identify processes and mechanisms and showcase how managers can and should integrate continuous innovation of business models within their core activities to achieve and maintain competitive advantage (Cavalcante et al. 2011; Demil and Lecocq 2010; Ritter and Lettl 2018; Zott et al. 2011). With that, we support Demil and Lecocq (2010) that both views are complementary rather than opposed to each other.

Third, we contextualize business model evolution for digital platform ecosystems (P3). We show how service firms evolve their business model toward multi-sided business models. We provide a novel perspective on platform evolution compared to prior studies that analyzed incumbents' evolution from an organizational perspective (Zhu and Furr 2016) or looked at platform startups (Brusoni and Prencipe 2009). With that, we bridge literature on business model evolution and platform evolution. Further, the results support incumbents changing their business models toward platforms (Dell'Era et al. 2020; Hein et al. 2019b). We answer calls to advance research on digital platform ecosystems concerning the implementation of launch strategies and the related business model changes (de Reuver et al. 2018).

Fourth, we show a two-sided connection between business model evolution and technology (P4, P5), which has received little attention from prior research (Baden-Fuller and Haefliger 2013). Our results support that technology needs to be embedded into business models (Chesbrough 2007), but further extend research by providing insights into how organizations can continuously and repeatedly leverage technology in business model evolution. We further address the ambidexterity challenge of balancing technology-driven vs. technology-induced BMI, albeit we only touch it and see that primary as future research. As such, we cannot observe self-reinforcing mechanisms triggered by technology during evolution (Bohnsack et al. 2014; Bohnsack et al. 2021). We show how to incorporate technology into the evolution of business models (Fichman et al. 2014; Rai and Tang 2014; Veit et al. 2014).

Fifth, we uncover mechanisms in place during the evolution of business models and antecedents and outcomes to the process (P3, P4, P5). Existing models and methods in this regard do not provide systematic guidance (Laudien and Daxböck 2016). The mechanisms provide a way to reduce the still necessary experimentation for BMI (Chesbrough and Rosenbloom 2002; Massa et al. 2017; Sosna et al. 2010). At the same time, they support that firms increasingly integrate external stakeholders into BMI, while opening the business model itself can provide additional value to customers. Further, we show how dynamic capabilities are antecedent to business model evolution. However, they are actually the outcome of it simultaneously. Based on a single case study, we further showed that organizational resilience can also be an outcome of business model evolution. Based on the mechanisms, we support how learning and sensemaking play a crucial role in the evolution of a business model (Nailer and Buttriss 2020) and specify how these mechanisms unfold and influence the value-creation logic.

Sixth, we show how the business model is a complex construct, with various interrelations not only with its surroundings but also within its components (P1, P2, P7). Based on the interrelations, virtuous and vicious cycles can emerge, as a change in one component can affect other components with a certain time delay. We underpin that dynamics within a business model emerge during its evolution based on interrelations between components (Ahokangas and Atkova 2020). A simple example is if an organization changes its sales channels, the market will take some time to adapt. Thus, a possible change in addressed customers takes some time, which can require new value propositions, other partners, or, quite simply, another possibility of payments. With that, we support the hypothesis of Ahokangas and Atkova (2020) to capture dynamic interrelations between components during a business model's evolution with complexity theory principles while not employing it ourselves.

12.2 Dynamic Capabilities as Antecedent and Outcome of Business Model Evolution

Recently, Teece (2018) discussed the relationships between dynamic capabilities and business models. Our research shows a relationship between dynamic capabilities and business model evolution (P5). We answer calls to study dynamic capabilities concerning BMI (Foss and Saebi 2017; Schneider and Spieth 2013; Teece 2017). Randhawa et al. (2020) showed how dynamic capabilities are antecedent in BMI. Our results support that view, but we extend the understanding of dynamic capabilities as simultaneously antecedent and outcome of business model evolution. With that, we enrich research on business model evolution and dynamic capabilities and demonstrate how both enable and build on each other. Further, we show how BMI can develop specific capabilities during business model evolution. We show how capabilities can be reconfigured and developed along business model evolution (Foss and Saebi 2017; Teece 2017).

Foss and Saebi (2017) stress investigating the role of dynamic capabilities as drivers of BMI, and Teece (2017) suggests studying BMI to understand dynamic capabilities in more detail. Our results support how dynamic capabilities can be a driver of BMI. However, our results show how they rather are the driver of the evolution of business models as a set of iterative BMIs, rather than one-time BMI. Further, our research underpins the suitability of using BMI as a lens to study dynamic capabilities. Our results show that dynamic capabilities indeed can also support BMI. However, we see a more nuanced view: dynamic capabilities support the evolution of a business model, and they do so with a mixture of modular and architectural BMI. However, the capabilities are leveraged for architectural BMI, while they are simultaneously manifested and used for modular BMI. We contradict understanding BMI as a dynamic capability itself (Amit and Zott 2016).

We further answer calls from research for the development of dynamic capabilities (Pentland et al. 2012; Schilke et al. 2018; Teece 2007), and more specifically, that it may proceed through typical stages over time (Fischer et al. 2010; Schilke et al. 2018). A model developed within this dissertation (P5) shows how dynamic capabilities can be developed through a series of BMIs. Further, based on a single case study (P5), we showcase explicit and repeatable mechanisms that support the development and manifestation of dynamic capabilities. Various of these can be transferred by practice, e.g., introducing "*innovation rounds*" consisting of different hierarchies and departments of an organization to discuss business models and innovation-related topics every week. Our results further show how routines build and manifest capabilities over time, a yet under-researched area (Vial 2019).

Dynamic capabilities use organizational processes and routines within their utilization. These can become path-dependent, leading to self-reinforcing mechanisms (Helfat and Peteraf 2009; Vergne and Durand 2011; Zollo and Winter 2002). Controversy, we did not observe path-dependencies in the use of dynamic capabilities. Still, our results support how dynamic capabilities can be reconfigured (Xie et al. 2022) within business model evolution. We further contribute to research on dynamic capabilities by showcasing explicit outcomes of using dynamic capabilities in combination with BMI. Research mainly provides generic outcomes, such as "*competitive advantage*", but does not provide a detailed description of actual practical outcomes. We observed different outcomes when utilizing dynamic capabilities. Some examples include

a strong identification of employees within an organization; the alignment of brands and business models; an increased speed to adapt business models; the possibility to offer after-sales business models; the ability to analyze customer behavior to achieve competitive advantage by customer-focused business models; or focusing BMI on more dedicated customer needs by leveraging separate organizational units.

12.3 Building Organizational Resilience with Business Model Innovation

Our results contribute to the literature on organizational resilience. We showcase how organizational resilience can be built with the help of BMI (P4). This supports the view that organizations can respond to external shocks with BMI, allowing new ways of value creation, capture, and delivery (Foss and Saebi 2017; Wirtz et al. 2015).

Organizational responses, allowed by resilience, lead to changes of a business model and can improve it (Casalino et al. 2019). This implies that in a resilient organization, the business model will change more often in case of external influences, increasing the need to understand business model evolution as an ongoing managerial task. That is even the case if an organization adapts itself to a situation without considering if and how it will innovate its business model based on that. Consequently, business model evolution can lead to increased organizational resilience. Our results support that view for the technology-driven evolution of business models within healthcare, as Chester et al. (2020) have shown for the domain of textile processing.

We further add to the research stream on the impact of crises on business models based on the concept of organizational resilience. Prior research looked at this phenomenon, analyzing the role of business models in the dot-com crash (Magretta 2002; Porter 2001), of financial crises (Altunbas et al. 2011; Hryckiewicz and Kozłowski 2017), and natural disasters (Ritchie 2004; Tsai and Chen 2011). We add to the recently emerged stream of business models and COVID-19 (Erdelen and Richardson 2021; Gregurec et al. 2021; Seetharaman 2020). Further, our research answers calls to understand resilience, e.g., by using information technology (Boh et al. 2020; Sakurai and Chughtai 2020). We show how long-term drivers, such as technology advancement and regulatory legislation, are interrupted by immediate triggers and how these triggers, in turn, lead to BMI. We witness how the evolution of business models is accelerated in complex and immediate situations of change, i.e., the COVID-19 pandemic. Furthermore, our results underpin how the COVID-19 pandemic might lead to a new normal of resilient organizations, similar to the 2008 financial crisis leading to the platform economy (Boh et al. 2020). Thus, business model evolution can result in forward-orientation in resilience and enables organizations to cope better with future crises.

12.4 Developing an exhaustive overview of requirements for business model tools

Software-based tools offer large potential for the innovation and management of business models. However, existing tools are often limited to business model design and visualization (Terrenghi et al. 2017). We support research in making more purpose-driven and accessible tools for practice (P6, P7). To do so, we identified key dimensions as functions software tools for business models can possess. Within these functions, we provide an exhaustive overview of requirements (Glinz 2007) and subsequent design principles, which were missing in existing research. With that, we enable future research to address business model-specific issues with

future tool development. We provide a starting point for the development of new business model tools. Furthermore, the results can serve as an evaluation framework for intermediate development states of prototypes and already existing tools.

The exhaustive review of requirements and design principles relevance can be understood when considering the roles involved in building and using a business model software tool, which has been neglected by prior research. Based on our observations made during this thesis, there are at least four roles. First, you have actual developers or software engineers who build and maintain the software artifact, often with limited to no business model-related knowledge. Second, you have business model experts. These typically offer the required content-related knowledge, decide, for example, which business model taxonomies should be used, and are often the primary source of requirements. Third, you have the actual user of the tool. Depending on a tool's functionality, these capture actual business models in a tool and generate different visualizations. Fourth, you have recipients of information generated within a tool, typically management or decision-makers. It is important to note that one person could take on several roles.

Based on these roles, several conflicts exist that can be partly solved with an exhaustive overview of requirements and design principles. First, for developers lacking business model-specific know-how, the design principles help to translate requirements into specific functionalities of an artifact that show a business model fit. Second, for business model experts, the requirements support them in expressing expectations toward non-functional requirements and improve communication with developers. Another conflict arises between users of a tool and recipients of information generated. The latter are interested in results, e.g., how different possible paths for innovation of a business model compare in specific KPIs or robustness. However, their interest in the actual process of using a tool is often limited. Thus, often a clear understanding of the basic functions of a tool is missing. In this case, the implications of specific results when using a tool, for example, a simulation, are not sufficiently understood. Additionally, the use of tools underlies various assumptions made by a user. While these can be expressed in a tool, these are not explicitly reflected in the actual results. That can lead to uninformed decision-making or cognitive biases. A still existing conflict in the stream of business model tools is thus finding a balance between offering easy-to-use tools, so decision-makers will also become users of such tools, and capturing the complexity of business models and dynamic interrelations. For business model evolution, this challenge in balance even rises. Managers need to understand the implications of business model evolution and dynamic interrelations of a business model first and, on top of that, the capabilities of a software artifact. As of now, this conflict remains unsolved.

The artifact developed as part of this thesis is among the first to offer simulation capabilities to capture the evolution of a business model and evaluate different business model design choices (P7). To realize this, we use system dynamics (Forrester 2009). Our results support the usefulness and suitability of using system dynamics in business model tools (Cosenz and Noto 2018; Moellers et al. 2019). Further, delayed cause-and-effect and feedback relationships can be captured (Groesser and Jovy 2016). However, improving the ease of use in creating simulation models remains a challenge, especially considering real-world, large data sets provide additional benefits but increase complexity.

13 Limitations

The studies embedded in this work and, as a result, the results of the entire work are subject to several limitations. While each publication covers a detailed discussion of its limitations, we will now elaborate on some general shortcomings of the research approaches and the concepts of BMI and business model evolution

The main limitation of **literature reviews** is their reliance on the search process and the documents identified therein. Even when relying on forward- and backward searches (Webster and Watson 2002), the search process may not cover all papers related to a given topic. This problem is complicated by numerous interpretations and different conceptualizations of business models and business model evolution (Massa et al. 2017). To mitigate this limitation, this thesis builds on several high-published literature reviews on business models and BMI (Foss and Saebi 2017; Massa et al. 2017; Schneider and Spieth 2013; Zott et al. 2011). Further, the analysis of literature reviews is prone to coding biases. For example, in a literature review on the interrelations among components of a business model (P2), coding depends on the researcher's interpretation of the interrelations and the selected business model taxonomy itself. To mitigate this problem, we used two coders for P1, three for P2, and two for P6.

Three publications of this thesis are **case studies** (P3, P4, and P5). Although case studies have many advantages, such as providing rich and in-depth information about a particular phenomenon, they also have some limitations. First, case studies cannot give a global truth, as they cannot be statistically generalized. Specific results can only be generalized to a certain extent and have no further validation, e.g., through cross-sectional analysis (Yin 2018). Furthermore, in our studies, we analyzed German and US companies. Germany and the US have specific types of cultures that can influence firms' behavior in terms of BMI (Hofstede and Bond 1984). Second, we conducted interviews, which we used as primary data. Interviews can include and raise some biases. In interviews, the researcher is the primary means of data collection. When conducting interviews, researchers rely on their skills and intuition. In addition, the interviewee may introduce a bias. The retrospective sensemaking bias, for example, covers "*knee-jerk*" reactions that can cloud conclusions (Eisenhardt and Graebner 2007). We used several interview partners in P3, P4, and P5 to mitigate this limitation. Further, we conducted three longitudinal studies. In this regard, some interviewees had to give retrospectives on different inquiries. We mitigated this issue by data triangulation. Further, as the phenomena studied reach up to three decades, the time intervals identified within the studies for specific episodes only have limited validity, underpinning the nuanced nature of the iterative process of business model evolution. However, process phenomena, such as the evolution of a business model, have, in general, a fluid character spreading out over both space and time (Pettigrew 1990, 1992).

There are also certain limitations to the methodology of **design science research**. There is little advice or guidance in the IS community on how to assess the contribution of DSR (Gregor and Hevner 2013). Part of the problem is that it is difficult to identify the key principles underlying the design; for example, our DSR study (P7) focused on the tool's core functionalities and thus only realized a limited set of requirements identified (P6). Further, describing the complexities of an artifact is only partly possible within a research paper (Gregor and Hevner 2013). The

level of design detail in a conference paper will vary based on the application domain, the designed artifact, and the audience to which the presentation is made. Furthermore, the evaluation of the tool prototype in P7 is demonstrated through the use of the artifact within a research project. While this is a valid evaluation method (Prat et al. 2014), it requires more iterations and user feedback. Another limitation of the evaluation of our DSR study is the focus on the tourism domain. Although this domain is well suited due to its rapid technological disruption, a large number of start-ups, and diversity of business models, future research could be conducted in other sectors to improve the generality of the results and their applicability to other domains.

Also, the **topic of business model innovation and business model evolution** comes with limitations. Different taxonomies of business models and different research streams on business models exist (Massa et al. 2017). The same is the case for research on BMI, the differentiation of different types of BMI, and the clear distinction of business model evolution (Foss and Saebi 2017). While we build on the most cited and highest published works on business models, BMI, and business model evolution, this still comes in as a limitation. Further, we analyzed the evolution of business models in three cases. The long-term behavior of some of these business models outside our analysis timeframe is unknown. Similarly, we cannot ensure that analyzed business models do not change in the future. We explored a specific timeframe only, and business models typically change over time. Thus, we cannot be sure that the proposed capabilities and mechanisms are still relevant in the future. However, they are a reasonable basis for extensions and further development of research on business model evolution and business model tooling.

14 Contributions and Implications

The findings of this dissertation have implications for both theory and practice, which we will elaborate on next.

14.1 Contributions to Theory

First, our results have implications for the literature on **business models** in general. Findings shed light on the concept of business model evolution, enhance our understanding of how business models evolve (P1 – P5), what role information technology takes in business model design and innovation (P3-P5), and contribute to research on the business value of IT (Kohli and Grover 2008; Schryen 2010; Steininger 2019). Further calls for research are addressed by investigating how traditional industries digitally transform (Matt et al. 2015). We additionally shed light on the complex interrelations within business models (P2) (Foss and Saebi 2018; Krumeich et al. 2012; Markides 2015) and the impact of crises on business models (P4) (Altunbas et al. 2011; Erdelen and Richardson 2021; Gregurec et al. 2021; Hryckiewicz and Kozłowski 2017; Magretta 2002; Porter 2001; Seetharaman 2020). Besides, this thesis has a methodical contribution. We provide three longitudinal case studies (P3-P5), which are scarce in business model literature.

Second, the results contribute to the literature on **business model innovation**. The review on business model dynamics (P1) and the insights derived by case studies (P3-P5) help to understand BMI in more detail. We show how BMI unfolds over time and elaborate on its antecedents and outcomes (Foss and Saebi 2017; Sjödin et al. 2020). The model developed shows the role BMI plays in the evolution process (P5). We further shed light on BMI in relation to platform-based business models (P4) and reveal how opening business models can enhance value creation. With that, we combine literature on BMI and platform emergence (de Reuver et al. 2018) and show how to leverage IT to innovate traditional business models (P3, P4, P5) (Bock and Wiener 2017; Johnson et al. 2008). Our findings further hint that technology-enabled BMI supports and accelerates the evolution of business models and underpin the growing attention of business model research in the information systems discipline (Alt 2020; Steininger 2019). We further combine literature on dynamic capabilities and BMI (P5). With that, we answer calls from research to investigate the role of dynamic capabilities as drivers of BMI (Foss and Saebi 2017) as well as to study BMI to understand dynamic capabilities (Teece 2017). We also address calls from research to study organizational resilience in relation to BMI (Casalino et al. 2019), showing how BMI can support firms in building and manifesting resilience.

Third, our results (P1-P5, P7) have implications for research on **business model evolution** (Bohnsack et al. 2021; Demil and Lecocq 2010; Saebi 2015). Business model evolution demonstrates the dynamics within a business model during its development over time and the necessity for managers to see the management of its evolution, by deliberate and emergent changes (Demil and Lecocq 2010), as a continuous task. We develop a model of business model evolution, contextualizing the phenomena (P5). With the model, we show how the ambidexterity challenge of a business model of innovating vs. exploiting (Sosna et al. 2010) can be addressed during its evolution, especially for technology-intensive industries (Balboni et al. 2019), and supports growth. Further, we show mechanisms (P4) in place during the evolution of business

models, antecedents, and outcomes. The mechanisms show how continuously extending the value proposition enhances growth and can be achieved by opening the business model logic, building and extending strong partnerships, and deliberately educating and training the network of partners. We further show how dynamic capabilities are simultaneously antecedent and outcome to business model evolution. Additionally, we bridge literature on business model evolution and platform emergence (P3) (de Reuver et al. 2018), supporting incumbents changing their business models towards platforms (Dell'Era et al. 2020; Hein et al. 2019a; Hein et al. 2019b).

Fourth, we enhance research on **business model tools**, specifically software-based ones. We enable researchers to build software-based artifacts based on an exhaustive overview of requirements (P6), answering calls in business model research (Szopinski et al. 2019). By offering design principles, we show practical ways to implement specific functionalities and provide a solution to offer tools capable of more than business model design and visualization (Terrenghi et al. 2017). Further, our results can serve as an evaluation framework for existing tools and intermediate development stages. By developing a tool prototype ourselves (P7), we are among the first to capture the evolution of business models with a software-based artifact. We show system dynamics (Forrester 2009) is applicable to capture business model dynamics and show the usefulness of this simulation technique for business model tools (Cosenz and Noto 2018; Moellers et al. 2019). Further, we show how interrelations between business model components (P2) lead to dynamics in a business model and can be reflected in tools (P7).

Outside the research stream of business models, our results have implications for research on **dynamic capabilities** (P5). We elaborate on dynamic capabilities' role in BMI and business model evolution (Foss and Saebi 2017; Schneider and Spieth 2013; Teece 2017). We answer calls from research to study the development of dynamic capabilities (Pentland et al. 2012; Schilke et al. 2018). We show how dynamic capabilities are developed through typical stages over time (Fischer et al. 2010; Schilke et al. 2018). Further, we elaborate on how routines support the building and manifestation of capabilities over time (Vial 2019). We further enhance existing research by showing concrete outcomes of utilizing dynamic capabilities in relation to an organization and its business models. One example is the alignment of brands and business models by dynamic capabilities.

We further add to research on **organizational resilience**. We present a real-life case that builds resilience and profits from it during the COVID-19 pandemic (P4). We show how organizational resilience leads to business model changes and improves a business model (Casalino et al. 2019). Further, we show how information technology enhances resilience, answering calls from research (Boh et al. 2020; Sakurai and Chughtai 2020). Our results show how organizational resilience enables firms to respond to external shocks with BMI (Foss and Saebi 2017; Wirtz et al. 2015). Further, our results show that business model evolution can develop and further strengthen organizational resilience, especially in technology-driven domains. Additionally, we show that organizational responses by BMI lead to forward-oriented resilience (Hamel and Välikangas 2003; Sutcliffe and Vogus 2003).

In summary, the findings of this thesis contribute primarily to research on business models, BMI, business model evolution, and business model tools. At the same time, contributions occur at intersections of research on business models and dynamic capabilities, organizational resilience, digital transformation, and platform emergence. The contributions strengthen the role of the business model as an essential theoretical construct in management research (Massa et al. 2017).

14.2 Implications for Practice

This thesis has several implications for practice, which firms can mostly apply when innovating and managing their business models. First, practitioners can use the findings of this thesis to **support business model innovation** in different ways. We demonstrate the importance of understanding business model evolution as a process comprising various BMIs cumulatively contributing to competitive advantage. Managers that innovate their business models help this process view (P3-P5) to **grasp the effect of time better**, enabling long-term thinking about BMI, i.e., actual business model evolution. More **informed decision-making regarding business models** is possible, understanding possible interrelations (P2, P7) of a business model and tangible outcomes of the process (P3-5, P7). By providing actual **mechanisms of business model evolution**, practitioners can evaluate if and how they can use these mechanisms to **manage their BMI endeavors** and discover **new opportunities**.

Second, findings illustrate how to **leverage advancements in IT** for new business models. Firms can learn from existing cases of business model evolution (P3-P5) how to digitally transform their business models. Our results give insights into different aspects, such as integrating technology into business models via M&A, using software-enhanced and open business models, and building cooperations to work on digital business models. Further, managers can evaluate the ambidexterity of technology-driven vs. technology-enabled BMI. Our results further prove how digital innovations create benefits over organizational boundaries, motivating managers to engage in actual value co-creation.

Third, we show organizations can **leverage dynamic capabilities in business model evolution**. Further, we show **how managers can build dynamic capabilities** engaging in modular BMI. We identify explicitly **dynamic capabilities that support firms to innovate their business models and show routines to build and manifest these capabilities**, e.g., by building separate organizational units or fostering company-wide BMI thinking with innovation days. Further, we give insights into specific outcomes organizations can achieve when building and using dynamic capabilities, such as aligning brands and business models or the ability to focus BMI on dedicated customer needs and offer customer-focused business models.

Fourth, practitioners can use the results to **deliberately build a resilient organization by BMI**. To do so, we show specific means (P3), e.g., mutual learning in partnerships, the coordination of strategic goals, or deliberate management of change. We show how business model evolution is accelerated in complex and immediate situations of change, such as the COVID-19 pandemic. As such, we give insights into how organizations can guide through impairment and quickly and effectively adapt to the situation

Fifth, we offer practitioners a **tool-based simulation approach to evaluate different directions of business model innovation**. Especially during the start-up phases of a business, each wrong decision can be fatal for a venture's survival in the long run. Further, trial-and-error learning can be harmful and even unfeasible, especially for start-ups, by losing potential customers with wrongful communication. Software-based business model tools, especially simulation-based approaches, can mitigate these risks and foster organizational learning. Using simulation models helps managers systematically assess the potential impacts of alternative decision scenarios toward a business model and to challenge their mental models toward the actual business models.

15 Future Research

During our research on business model evolution and business model tools, several new research questions emerged, which are out of the scope of this thesis and provide fruitful avenues for future research.

Establishing business model evolution as a profound theoretical construct for research. Our work is among the first steps to promoting business model evolution as a theoretical construct for research, despite increasing interest in research (see Section 2.3). However, more research is needed to interweave the different interpretations of business models (Massa et al. 2017) and business model evolution (Demil and Lecocq 2010; Foss and Saebi 2017). Thus, business models can serve as a foundation for various topics in future information systems and management research. Future research can build and extend the model on business model evolution developed as part of this thesis by qualitative empirical studies.

Studying mechanisms, antecedents, and outcomes of business model evolution. Future research can use our results to further look at mechanisms in place during business model evolution and antecedents and outcomes of this process. We have uncovered four mechanisms specific to platforms. More studies in different domains and organizations can reveal further mechanisms or refine and extend the identified mechanisms. Further, analyzing firms that use several business models in parallel will enable investigating spillovers and synergies between the innovation of different business models. Future research can also focus on the time factor in business model evolution. We expect too much acceleration within that process could turn out harmful in the end and harm the balance of a business model. At the same time, analyzing when is the "*right*" time to introduce an entirely new business model (i.e., architectural BMI) instead of modular innovating an existing one is an interesting research question. Future research can focus on this ambidexterity within business model evolution. Further, the antecedents of business model evolution are a fruitful avenue for further research. An interesting point of consideration is studying business model evolution outcomes. We have identified outcomes of evolution, which, however, stem from single case studies and only offer limited generalizability.

Evaluation of other theoretical constructs in relation to business model evolution. While we have seen business model evolution, dynamic capabilities, and organizational resilience are interrelated, additional constructs could explain certain phenomena around business model evolution. We have observed these concepts as they inductively emerged through case studies. However, we identified other constructs within literature reviews that future research can build on. Strategic agility (Doz and Kosonen 2008; Doz and Kosonen 2010) can provide a fruitful avenue, especially from a practitioner's perspective. Further, embedding business model evolution within organizational learning theory (Levitt and March 1988; Loon et al. 2020) can shed light on knowledge-driven processes during evolution. More broadly, absorptive capacity theory (Cohen and Levinthal 1990), diffusion of innovations theory (Rogers 1962), or theory of organizational sensemaking (Weick et al. 2005) could be used in future research to provide novel insights from different perspectives.

Qualitative and quantitative studies on business model component interrelations. We identified various interrelations between business model components within literature reviews

and case studies. These compose the business model as a complex system and can induce dynamic behavior. Based on our results, future research can employ either empirical qualitative approaches, such as multiple-case studies, or quantitative studies to assess existing interrelations between business model components. An exciting consideration is specific interrelations leading to virtuous or vicious cycles, by studying particular types of BMI, for example, analyzing a high number of cases that switched to a subscription-based revenue model. Further, examining the interrelations of existing business models within specific domains can reveal domain-specific knowledge enabling better decision-making regarding BMI. A large-scale case database could further help to look at interrelations and cycles within different business model taxonomies.

Evaluating the role of information systems in business model evolution. We have touched on the use of IS in business models and observed various cases of technology-driven or technology-enabled BMI within the case studies. Further studies can build on these initial findings and focus on whether and how technology and its development support BMI or rather creates the need to adapt. Our initial findings hint that technology-enabled BMI supports and accelerates the overall evolution of business models. However, often it is not the business model itself, which is the focus of innovation, but organizational change projects to digitize an entire organization. These digital projects are becoming increasingly complex, and digital BMI requires a more diverse set of professionals. Future research can analyze how IT advancements change BMI approaches and processes. This is also a fertile area for research as we even expect the emergence of service platforms for BMI.

Gathering purpose-specific requirements and design principles for business model tools. We provide a rather exhaustive but generic overview of requirements and design principles for business model tools. Future research can build and extend our results in two ways. First, further empirical studies building, for example, on interviews, surveys, and workshops, can extend the existing requirements and develop more diverse design principles. Second, a purpose-specific adoption of the design principles can provide better guidance for tool development and assessment of already existing solutions. These purpose-specific principles can focus on a tool's core functionalities, e.g., supporting the modeling, enhancing creativity, building on best practices such as patterns, and simulating possible innovations. They could also focus on specific types of BMI, e.g., changing to a service-based logic, introducing recurring revenues, or co-creating value within a network. We expect these results to provide a helpful instrument for developing suitable business model tools.

Developing simulation-based business model tools using large-scale data sets and machine learning methods. We see a tremendous opportunity for business model research to impact practice by developing a new class of tools. The use of machine learning has increased significantly within the last decade. Machine learning addresses how to build machines that improve performance through data and experience (Jordan and Mitchell 2015). With these new possibilities, future tools can integrate machine learning components and allow for more informed and semi-automated decision-making on the level of the business model. To realize this, large-scale data sets are necessary. This can be either achieved by creating open databases of real-life business models and BMI from various organizations. One possibility is to automatically assess

business models with natural language processing methods from standardized reports. Another way to assess large data sets on the organizational level is to create interfaces to Enterprise-Resource-Planning systems (ERP) and directly build on this data. By this, a current view of an organization's actual business models, interrelations, and possible innovation paths become possible. This can create live business model dashboards for a specific organization and BMI recommenders.

16 Conclusion

As firms increasingly compete on business models, their innovation is crucial for long-term success. However, many BMI initiatives fail. This problem increases when considering the bigger picture, as innovating a business model once is insufficient with changing market conditions and technologies and considering business models evolve. Therefore, this thesis develops an empirical understanding of business model evolution. We structured literature on business model dynamics and showed interrelations between business model components leading to the dynamic behavior of business models. We conducted three longitudinal case studies, contextualizing business model evolution and revealing the increasing role IT takes in business model design and innovation. Results contribute to the business model and information systems literature by supporting business model evolution as a theoretical construct for research and showing how IT shapes new business models and innovation processes. For practice, we provide applicable mechanisms of business model evolution and routines to manifest dynamic capabilities within BMI and show how software-based tools can enhance decision-making. Future research can extend findings on various facets of innovation and business model evolution towards a profound theory on business models.

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Appendix. Published Articles in Original Format

Appendix A. Dynamic Business Models: A Comprehensive Classification of Literature (P1)

2019

DYNAMIC BUSINESS MODELS: A COMPREHENSIVE CLASSIFICATION OF LITERATURE

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DYNAMIC BUSINESS MODELS: A COMPREHENSIVE CLASSIFICATION OF LITERATURE

Research full-length paper

General Track

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Abstract

Business models are vital to companies' success; to stay competitive, companies continuously adapt and innovate their business model. The conceptualisation of business models has received much attention from prior research and the focus of research is shifting from a static perspective to a more dynamic perspective. This research is a comprehensive and up-to-date literature analysis of the concept of dynamic business models. To achieve a systematic and objective penetration of the research field, we used a classification framework consisting of 15 evaluation dimensions. We identified the main research streams on the topic and present the most relevant approaches, such as system dynamics modelling. A total of 42 relevant literature sources were found. Finally, we highlighted gaps for future research, such as a need for more detailed analyses of the interdependencies between the components a business models consists of.

Keywords: Dynamic Business Model, Literature Review, Innovation, System Dynamics, Interdependencies

1 Introduction

Business models (BMs hereinafter) are vital to companies' success (Zott et al. 2011) and have gained increased attention in research and practice in recent years (Wirtz et al. 2016). Due to high-velocity markets, fast changing requirements of customers and stakeholders, and the increasing maturity of the concept itself (Foss and Saebi, 2017; Wirtz et al. 2016), scholars as well as practitioners have criticized the adaption of a too static perspective regarding BMs (Chesbrough, 2010; Cosenz and Noto, 2018; Demil and Lecocq, 2010; van Putten and Schief, 2012). This has led to a shift in focus of BM research toward a more dynamic perspective (Burkhart et al. 2011; Kranz et al. 2016; Saebi, 2015; Schneider and Spieth, 2013). In general, according to Burkhart et al. (2011) a dynamic point of view on BMs addresses the evolution process of a BM. This perspective allows a firm to adapt a BM flexibly and dynamically to stay competitive, to continuously manage it, to anticipate changes and to innovate it (Achtenhagen et al. 2013; Basole, 2009; Chesbrough, 2007; Cosenz, 2017; Kranz et al. 2016; Spiegel et al. 2015). Especially in the digitized world, companies have problems adapting their BM to the new challenges and the increased speed of the market and innovations (Saebi, 2015; Simmert et al. 2018). Additionally, companies often follow a trial-and-error approach or intensive experimentation to develop a new BM or change an existing one, which can be expensive and risky.

Firms with a proactive BM capture and generate high value in dynamic markets, compared to a reactive BM (Hacklin et al. 2018). However, it is not understood in detail how a BM evolves and develops over time. This evolution is caused, to a large extent, by the complex and dynamic relationships between the components of a BM, which are not sufficiently understood (Burkhart et al. 2011; Chen et al. 2019). Most BM representations still rely on static views (Chen et al. 2019) and there are only limited methods and tools to address the shift toward a dynamic perspective (Achtenhagen et al. 2013). More flexible BMs are needed, enabling firms to modify their strategic choices in a constantly changing environment (Trimi and Berbegal-Mirabent, 2012) and allowing practitioners to make better BM decisions (Täuscher and Chafac, 2016). Current approaches apply a variety of definitions on BMs from a dynamic perspective and focus on varying topics, leading to an unclear state of knowledge regarding the subject. To the best of our knowledge, no exhaustive review of dynamic business models (DBM hereinafter; see e.g., Cosenz and Noto, 2018) exists. Within this research, we aim to shed light on the concept of a "dynamic business model". The overarching question this study addresses is: **What is the current state of knowledge regarding Dynamic Business Models?** To address this question, this paper provides an up-to-date literature analysis based on four research goals (see Table 1).

Research Goals of this Paper
• Provide an up-to-date and cross-disciplinary overview of definitions and concepts related to dynamic business models • Classify existing literature on the topic of dynamic business models • Develop a clear definition of a dynamic business model, and the benefits this concept provides • Uncover existing research gaps that should be tackled to provide conceptualizations and tools for dynamic business models

Table 1. Research Goals of this Paper

The structure of the paper is as follows. In Section 2, we elaborate on the methodology applied to this study. Applying this methodology, Section 3 introduces different concepts, terms and definitions on the topic. To achieve a systematic and objective description of the research phenomena, in Section 4 the selected literature sources are classified within 15 dimensions, clustered into six categories in order to reduce complexity. Based on this, Section 5 presents the central themes in research about DBM. Before the conclusion in Section 7, avenues for future research are presented in Section 6.

2 Methodology of the Literature Review

This research is a systematic literature review following the guidelines of Webster and Watson (2002). A broad foundation of journal and conference papers was assembled using the database Scopus. The database was selected because it has a wide coverage of scientific literature. Additional databases were used to retrieve literature not available in Scopus. To guarantee the use of high-quality literature, we selected as sources the IS Basket of 8[1], the top 10 strategy and management journals according to their impact factor[2] and the top IS conferences (HICCS, ICIS, ECIS, AMCIS, MCIS). During a forward and backward search, it was clear that the journal *Long Range Planning* was of central relevance for the topic, so we added it to the initial list of primary sources.

Within these sources, we searched for the term "business model" in the title, abstract, or keywords, without further limitations of the search term, such as *dynamic**, *evoluti**, or similar terms. Prior to this research, it was not fully clear what topics and terms in the context of DBM would be addressed by the various studies. Applying a broad scope allowed a rather open approach, and did not limit possible results by a too restrictive search stream. This search provided us with a set of 326 articles. Additional journal articles, conference papers and studies appearing in books and dissertations were added with a forward and backward search.

Following a two-stage selection process, the articles were scanned and filtered in two rounds. The initial cursory analysis reviewed the titles, abstracts, keywords, and the introductions of the documents. This revealed that not all of the identified articles would be useful for the purpose of this review, because the respective work did not deal with the business model as a central concept within the article. In this step, the number of relevant articles was reduced from 326 to 177. In the second stage, the articles' results and conclusions were reviewed. In this stage, we deemed papers that solely applied the concept in a static way or as means of representation as not relevant and excluded them as well. The resulting sample papers were read in detail and classified. The final sample consisted of 42 relevant literature sources. To classify the selected articles, we used an explorative process that was repeated iteratively to develop conclusive classification constructs for each of the classification dimensions (Dongus et al. 2014).

3 Heterogeneous Definitions of Dynamic Business Models

The variety of research streams dealing with the concept of BMs lead to a diverse set of definitions. However, recent reviews to the emergence and conceptualizations of BMs exist, e.g., Wirtz et al. (2016), Massa et al. (2017), Zott et al. (2011) and Foss and Saebi (2017), who realize that the majority of current definitions of BMs are close to Teece's definition as "the design or architecture of the value creation, delivery, and capture mechanisms" (Teece, 2010).

On the topic of DBMs few reviews exist. Foss and Saebi (2017) offer a broad overview of BMs and business model innovation (hereinafter BMI), which also covers aspects of DBMs. However, coverage of BMI is regarded to be insufficient (Chesbrough, 2007; Ricciardi et al. 2016; Taran et al. 2015), as changes or reconfigurations of a BM and its constituting components often occur on a more nuanced level, not always leading to radical BMI (Clauß et al. 2019). Massa et al. (2017) give a comprehensive overview of BM research, briefly addressing DBMs. Currently however, there has been no exhaustive review regarding DBMs.

[1] https://aisnet.org/page/SeniorScholarBasket

[2] https://www.scimagojr.com/journalrank.php?category=1408

To tackle the first research goal proposed in the prior section and attempt to grasp the different approaches, Table 2 provides a brief overview of different concepts and their respective definitions in relation to the concept of DBM. These guiding references provide an overview of selected studies using the respective term, but are by no means exhaustive. The concepts and definitions are relevant within the topic of DBM and proposed by, among others, the provided guiding references. Furthermore, pertinent research streams and approaches, such as BM transformation, are defined.

Concept	Understanding / Definition	Guiding references
BM change	Four types of BM change exist: BM – creation; extension; revision; termination (Cavalcante et al. 2011)	Cavalcante et al. (2011); Kranz et al. (2016)
BM evolution	"[…] a fine tuning process involving intended and emergent changes both between and within its [a BM] core components." (Demil and Lecocq, 2010)	Bohnsack et al. (2014); Burkhart et al. (2011); Demil and Lecocq (2010)
BM adaptation	"[…] the process by which management actively aligns the internal and/or external system of activities and relations of the business model to a changing environment." (Saebi, 2015)	Kurti and Haftor (2014); Ricciardi et al. (2016); Saebi (2015)
BM innovation	"A business model innovation happens when the company modifies or improves at least one of the value dimensions." (Abdelkafi et al. 2013)	Abdelkafi et al. (2013); Foss and Saebi (2017)
BM transformation	"[…] a transformation process of the value creation caused by external or internal changes." (Augenstein et al. 2018)	Augenstein et al. (2018)
BM evaluation	(No explicit definition provided)	Burkhart et al. (2011); Kayaoglu (2013)
BM (re)configuration	"[…] the phenomenon by which managers reconfigure organizational resources (and acquire new ones) to change an existing business model." (Massa and Tucci, 2014)	Clauß et al. (2019); Di Valentin et al. (2013); Massa and Tucci (2014)
BM management	"A generic management process, building on the business model as central unit of analysis." (Terrenghi et al. 2017)	Ebel et al. (2016); Terrenghi et al. (2017)
BM improvement	Radical improvement as "the complete revision of their [a company's] business model" (Simmert et al. 2018) Incremental improvement as the revision only of parts of a business model (Simmert et al. 2018)	Simmert et al. (2018)
Dynamic BM	(No explicit definition provided)	Cosenz and Noto (2018); de Reuver et al. (2009); Meier and Bosslau (2012)
BM dynamics	(No explicit definition provided)	Achtenhagen et al. (2013); Di Valentin et al. (2013); Saebi (2015)

Table 2. Concepts and Definitions Regarding Dynamic Business Models

Different authors, as presented in Table 2, use different approaches and a variety of concepts in the context. Often, the relation between these approaches seems unclear or is not defined. The variety and heterogeneity of these definitions and related concepts shows that DBM lacks clear conceptualization. To better comprehend and understand the variety of approaches dealing with DBM, it is first necessary to classify the existing literature (see Section 4).

4 Classification of Existing Literature

With the literature review specified in Section 2, we identified 42 relevant literature sources. These sources are classified based on 15 dimensions, which are aggregated into six categories (see Table 3). This classification helps to achieve the second research goal proposed in the first section.

We developed the categories and the respective dimensions within the iterative process of reviewing the literature. All of the categories and dimensions are supported by literature, notably, not one single source provides exactly these dimensions. Rather, these are parts of the results within this research. The totality

of the categories is not arbitrary and the justification for using the respective category is explained in detail within this section. Additionally, the dimensions within the categories are presented and analyzed. Table 3 presents the classification framework.

Category	Dimension		
Perspective	static	dynamic	
Lifecycle stage	develop	exploit	
Interdependencies	intra-BM	intra-organizational	external
Process view	change	management	capabilities
Tool support	representation	development	simulation
Focus	domain	use case	

Table 3. Classification Framework

First classification category: Perspective on business models

Static and dynamic perspectives on the concept of BM can be found in the literature (Burkhart et al. 2011; Demil and Lecocq, 2010; Kranz et al. 2016; Schwarz et al. 2017). From a *static perspective*, a BM describes the current state of a company and its methods for generating value. Literature in this context often refers to a *static blueprint* (Bouwman and MacInnes, 2006; Burkhart et al. 2011). This perspective is useful for discussion or analysis purposes. From a *dynamic perspective*, mainly the process of BM evolution is addressed. This includes internal and external factors influencing a BM (e.g., market changes, legal regulations, internal strategy, capabilities), the process of managing and changing a BM, as well as interactions between the components of a BM.

Dimensions: *static perspective, dynamic perspective*

Second classification category: Business model lifecycle stage

A BM evolves through different stages over time, posing different implications during the different stages (Christensen et al. 2016; Rong et al. 2018). Understanding in detail the different stages, and having the ability to locate a BM within the lifecycle, is important in decision making.

There are a variety of models describing the lifecylce of a BM, e.g., Burkhart et al. (2011); Christensen et al. (2016); de Reuver et al. (2009); Ebel et al. (2016); Gassmann et al. (2013); Pateli and Giaglis (2004); Simmert et al. (2018); Terrenghi et al. (2017). Varied authors use different stages to describe the lifecylce of a BM; these approaches mostly differ in focus and granularity of the respective stages. Yet, these models mostly share the same basic structure. We summarized the different models into a 6-staged lifecylce model. The two distinct stages, *develop* and *exploit*, are shown in Figure 1. Even though these two stages are rather generic, they help to understand in which stage the respective BM concept is applied in within the literature source.

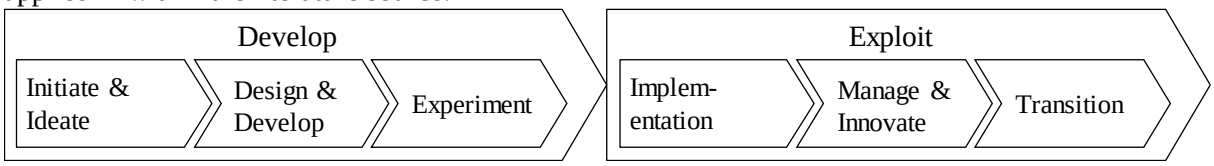

Figure 1. Generic Lifecycle Stages of Business Models

Dimensions: *develop, exploit*

Third classification category: Interdependencies

To understand DBMs, it is important to understand the complex interactions (structural relations) between the constituting components of a BM as well as with other, external influences. We use the following three dimensions to classify literature addressing these interdependencies.

Literature considering *intra-BM interdependencies* looks at the complex interrelations between different components (often referred to as building blocks or elements) of one particular BM. Amit and Zott (2001) with their work on e-BMs have already noted the interdependencies of value drivers and their

mutual enhancement. These interrelations can occur between two distinctive components of a BM, as well as within one specific component, e.g., between resource configuration and the revenue model. Furthermore, the literature looks at the interrelations of a BM and its components with further *intra-organizational interdependencies*. These refer to interdependencies within the organization (e.g., the company's strategy) and lead to the evolution of a BM over time as well. This evolution process happens either consciously, to support the company's strategy, or mostly passively, meaning there is no specific involvement of the operator of the BM. The third dimension that considers interdependencies are papers focusing on e*xternal interdependencies* and the interplay of a BM with its external environment. Typically, external interdependencies are regulation, competition in general, ecosystem dynamics, changing customer satisfaction patterns, or the change of a partner's BM.

Dimensions: *intra-BM interdependencies, intra-organizational interdependencies, external interdependencies*

Fourth classification category: Dynamic process view

This classification category evaluates how a respective paper addresses DBM from a process perspective, i.e. how inherent dynamics are addressed. To classify the papers, we used the following three dimensions.

The dimension *change* mainly considers three streams: the evolution of a BM over time; the process of changing a BM; and the kind of changes that are possible to a BM at different lifecycle stages (Christensen et al. 2016). The dimension *management* refers to the process of controlling and monitoring a BM. The final dimension in this category focuses on the *capabilities* necessary to benefit from inherent dynamics of the BM, for example, by proactive change or by managing it accordingly. The biggest share of these approaches builds on dynamic capabilities (Teece et al. 1997; Teece, 2018), with different variations of the concept.

Dimensions: *change, management, capabilities*

Fifth classification category: Tool support

Researchers have been asking for tool support to develop and manage BMs. Existing tools are helpful within the process of BMI, but do not sufficiently support the design, exploration, and management of a BM and do not leverage the full potential of tools (Achtenhagen et al. 2013; Athanasopoulo et al. 2018; Ebel et al. 2016; Giessmann and Legner, 2016; Simmert et al. 2018; Veit et al. 2014). Additional, Athanasopoulo et al. (2018), in a recent paper about tooling for BMI, report that existing tools do not consider the creation of alternative BMs within a dynamic environment, which poses uncertainty. To understand if a respective paper provides tool support, in this review, we differentiate the category of tool support within the following dimensions: *representation*, as a tool for describing and communicating a BM; *development*, as a tool to support the development of a DBM; and *simulation* as a tool to simulate the behavior of a DBM.

Dimensions: *representation, development, simulation*

Sixth classification category: Focus

To classify the selected literature more comprehensively, we additionally evaluated the focus of the literature sources. This category supports understanding and reasoning why and how a specific approach may propose specific or generic results. Within this category, we differentiate between *domain specific*, when a paper considers a specific domain such as in the biomedical sector (e.g., Willemstein et al. 2007) or in the 3D printing industry (e.g., Rong et al. 2018) and *use case specific*, if one or several specific use cases are addressed (e.g., Moellers et al. (2019) studying cases within BMW or Demil and Lecocq (2010) studying the case of the English football club Arsenal FC). Some papers build on a generic framework, and then evaluate it with a use case. However, this does not necessarily mean the respective research focuses solely on a specific use case or domain.

Dimensions: *domain specific, use case specific*

Table 4 provides an overview of the classification of the 42 literature sources. The detailed description of each of the classification categories already delivers first insights into the research stream. In the next section, we present the key insights based on this classification.

	perspective		BM stage		interdependencies			process view			tool support			focus	
	static	dynamic	develop	exploit	intra-BM	intra-organizational	external	change	manage-ment	capabilities	representa-tion	develop-ment	simulation	domain	use case
Abdelkafi and Täuscher, 2016		x	x	x	x	x	x	x			x		x		x
Achtenhagen et al. 2013		x	x	x		x		x	x	x		x			
Amit and Zott, 2016		x	x							x					
Augenstein et al. 2018		x		x	x	x		x				x			x
Burkhart et al. 2011	x	x	x	x		x		x	x						
Bohnsack et al. 2014		x		x	x		x	x						x	
Bouwman and MacInnes, 2006				x		x		x			x				x
Cavalcante et al. 2011	x	x	x	x	x	x		x		x					
Chen et al. 2019		x	x		x								x	x	
Clauß et al. 2019		x		x	x	x		x	x					x	
Cosenz and Noto, 2018		x	x		x	x					x		x		x
Demil and Lecocq, 2010	x	x		x	x	x	x	x		x					x
Desyllas and Sako, 2013		x		x	x	x		x		x					x
Di Valentin et al. 2013		x	x	x	x	x	x		x			x		x	
Ebel et al. 2016	x		x			x	x		x			x			x
Giessmann et al. 2013		x	x									x	x		x
Haaker et al. 2017		x	x		x	x	x	x				x			x
Hajiheydari and Zarei, 2013		x	x		x		x	x					x		x
Kayaoglu, 2013		x	x	x	x	x						x			x
Kurti and Haftor, 2014		x	x					x							
Kranz et al. 2016		x		x		x	x	x		x					x
Krumeich et al. 2013		x			x						x				
Krychowski and Quélin, 2014		x	x		x		x	x						x	
Kulins et al. 2016	x		x			x								x	
McGrath, 2010		x	x		x	x		x		x					
Meier and Bosslau, 2012		x	x		x	x	x	x					x	x	
Moellers et al. 2019		x	x	x	x	x		x					x		x
Ojala, 2016		x	x	x	x	x	x	x							x
Rai and Tang, 2014	x			x	x		x	x		x				x	
de Reuver et al. 2009		x	x	x			x	x						x	
Ricciardi et al. 2016	x	x		x	x	x		x		x					x
Rong et al. 2018		x	x			x	x			x				x	
Saebi, 2015		x		x		x	x	x		x					
Schwarz et al. 2017		x	x	x		x	x		x						
Simmert et al. 2018	x		x	x		x			x			x			
Täuscher and Chafac, 2016		x	x		x	x	x	x					x		x
Teece, 2018		x	x		x	x		x		x					
Terrenghi et al. 2017		x		x	x	x	x	x	x						x
Valter et al. 2018		x		x		x	x	x							x
van Putten and Schief, 2012	x	x		x		x									
Weking et al. 2018		x		x	x	x		x						x	
Willemstein et al. 2007		x		x			x	x						x	
Total (n=42)	**9**	**36**	**26**	**26**	**25**	**31**	**20**	**29**	**8**	**12**	**3**	**8**	**8**	**12**	**18**

Table 4. Classification of the selected literature on DBM

5 Central Themes in Research on Dynamic Business Models

In Section 4, the relevant classification categories were introduced and described in detail. Based on the classification shown in Table 4, several patterns in the comprehension of DBMs are identified and analyzed, including the most relevant approaches within these patterns. In the next section, we present avenues for future research, acknowledging gaps in the prior literature.

Analyzing the 42 literature sources in detail and building on the scientific state of knowledge, we argue to extend the definition of BM by Teece (2010) as "the […] architecture of the value creation, delivery, and capture mechanisms" by the following aspects to provide a current understanding of DBM. A BM:

- is exposed to uncertainty by various internal and external influences
- is a complex construct, consisting of interrelated components
- [and it's constituting components] evolves over time

Based on these aspects, we understand *DBM as a complex system of interrelated subcomponents of the value creation, delivery, and capture mechanisms, which is interacting with heterogeneous internal and external influences leading to the evolution of its components and the system itself.*

The process of business model evolution

The prior literature has studied the process of BM evolution. Evolution is how a BM develops over its lifecycle. As presented in Section 4, the literature has proposed lifecycle stages for the construct of BMs. Yet, these stages show an idealized and generic process. However, the evolution of a BM happens on a more nuanced level, as its interdependent subcomponents experience varied changes (Ricciardi et al. (2016) refer to "microadaptations"). The existing literature mostly looks at this occurrence rather superficially. Even detailed studies, such as the study by Demil and Lecocq (2010) analyzing the case of the English football club, Arsenal FC, over a period of ten years, often lack detailed insights on the subcomponent level. Other studies consider the actions or capabilities necessary to handle these dynamics, such as Achtenhagen et al. (2013), but do not consider the concrete process as well. Some studies even understand BM change as a dynamic capability in itself (e.g. Saebi, 2015). Other studies build on dynamic capabilities, e.g., Ricciardi et al. (2016) who proposed the concept of "adaptive business model innovation". Further capabilities that are proposed to address inherent dynamics of a BM are: IP-management capabilities; managerial capabilities in general; absorptive capabilities or organizational capabilities as constructs from organizational theory. These studies, however, give little indication on how to employ these capabilities to handle DBMs.

In general, the process of evolution is not understood sufficiently. A more detailed look at the concrete interrelations of the subcomponents, as well as the interaction of these components in the internal (organization) and external (environment) surroundings is necessary (see the next sub-section). Furthermore, empirical research studying successful, as well as failed cases over a longer period are needed to provide detailed insights from practice. If these empirical studies use a harmonized taxonomy to describe BMs and its evolution process, the development and testing of more generic hypothesis is possible.

Improving the understanding of the evolution process can help to evaluate the robustness of a BM, as proposed by Haaker et al. (2017), but more importantly, it helps to understand how the environment influences its evolution and the concrete impact of a specific change in a subcomponent on the other subcomponents. This knowledge will help managers to make better decisions regarding BM design and management (Christensen et al. 2016). Currently, changes in BMs are mostly either reactive or even unconscious. Having more profound knowledge, the evolution process of a DBM could be purposefully and actively steered to achieve the organization's desired goals efficiently and effectively. Necessary adaptions and beneficial changes can be evaluated and performed anticipative. Cavalcante et al. (2011) provided a detailed study, proposing four kinds of BM change and the respective key challenges; these results help to evaluate the impact of changes on a BM.

Interdependencies: Understanding dynamic business models as complex systems

We found three dimensions of interdependencies of DBM, which lead to reinforcing dynamics (feedback loops): *intra-BM interdependencies, intra-organizational interdependencies,* and *external interdependencies*. The literature considering *intra-BM interdependencies* looks at the interrelations between different components of a BM. As the components change over time (Demil and Lecocq, 2010), the dynamics caused by these interrelations are again reinforced. This means that the evolution of one BM component might lead to an increasing significance or changing configuration of another component (Abdelkafi and Täuscher, 2016). Feedback loops arise, building vicious ("weakening") or virtuous ("strengthening") cycles. An example is the changing BM of the airline Ryanair described by Casadesus-Masanell and Ricart (2011). Some studies employ a systems perspective to understand intra-BM interdependencies, which are described in the next sub-section. *Intra-organizational interdependencies* consider the interrelations between a BM and its subcomponents with the BM's governing organization. Mostly qualitative interdependencies are used. The most frequent intra-organizational interdependency

considered in the literature is the strategy of a company[3]. Some studies looks at a company's information systems, its general network of partners (not for the specific BM, but the company as a whole), the organizational process, and the managerial cognition of the responsible executive. One specific intra-organizational influence can be seen in the interrelations between competing or complementing BMs of the same company. This research stream mainly focuses on the management of a BM portfolio (see for example, Schwarz et al. 2017), such as a news agency offering a printed newspaper, a basic online news homepage, and a premium online offering with detailed reports and analyses. The third stream found is the study of *external interdependencies* and their influence on the BM and its components. Typically, external interdependencies are regulation, competition in general, ecosystem dynamics (e.g., Rong et al. 2018 in the domain of 3D-printing), changing customer satisfaction patterns, and further external developments, e.g., sociological changes leading to a shift of the BMs of a whole domain. De Reuver et al. (2009) provide a detailed study of external influences on start-up BMs over their lifecycles.

Even though previous studies look at a variety of interdependencies affecting a BM [25/31/20 *intra-BM* / *intra-organizational* / *external]*, it is still not understood sufficiently what concrete interdependencies influence a BM and in what manner. There are detailed studies available that look at competing BMs (Markides and Charitou, 2004) or BM portfolios (Schwarz et al. 2017); Krumeich et al. (2013) even provide a literature review on the topic of interdependencies of BMs. Yet, most of the studies found in this analysis only provide insights on which factors influence a BM, but do not specify how these factors influence the BM or what components are affected. To improve the understanding of DBM's interdependencies, the DBM should be understood as a complex system. According to Simon (1962), complexity occurs, "when a number of parts interact in a nonsimple way." Such complexity often takes the form of a system that is composed of interdependent (complementary) subsystems (Foss and Saebi, 2017; Simon, 1962). Several studies apply simulation approaches considering the variety of interdependencies in detail; these are presented in the next sub-section.

Simulation models for dynamic business models

The studies that take a systemic understanding of DBM use various modeling and simulation approaches to provide insights on the underlying causal effects. Most of the literature employs causal loop diagramming to study the implications of changes (i.e., mostly managerial decisions) and to understand feedback loops (virtuous cycles) within a DBM. On a more detailed level, simulation models are used to describe DBMs as complex and evolving systems. The most-used simulation approach is system dynamics, e.g., Cosenz and Noto (2018); Moellers et al. (2019); Romero et al. (2017). Additionally, agent-based modeling is used occasionally. System dynamics was developed in the 1950s to holistically model complex systems (Forrester, 1997); it can be used to evaluate different options in the design of a DBM by simulation and empirical assessment (Täuscher, 2018).

While these approaches mostly are case specific, they deliver concrete insights on the reinforcing dynamics of a BM and support an understanding of the evolution process. It is necessary to compare and analyze these specific findings in order to provide more insights into the interrelations and the underlying dynamics. Empirical investigations are necessary to identify specific interaction patterns within and between BM components as well as with external interdependencies, which can provide more generic propositions. Knowledge of this phenomena will help to further understand the internal structure of a BM and serve as a basis to support better decision making in BMs, to develop more flexible and long-lasting BMs, and provide a basis for more sophisticated tools for BM development and management.

Yet, for the existing simulation approaches, detailed knowledge to build the respective simulation models is needed. Furthermore, because there is no unified language to describe DBMs, it is difficult to build an empirical dataset to derive more generic hypotheses from the models. More sophisticated tools are needed, which can be used by practitioners without profound knowledge of simulation models. To do

[3] Literature also looks in detail between the relation or distinction of a BM and the strategy of a company. A detailed discussion can be found for example in Massa et al. (2017).

so, a combination of explorative or strategic methods, which are easier to comprehend, could be helpful and should be tested in the future. To build different strategic options that can be modeled and simulated, scenario planning used by Haaker et al. (2017), scenario development used by Täuscher and Chafac (2016) or strategic thinking proposed by McGrath (2010) are suitable. The concrete combinations and the benefits will have to be evaluated in the future and can serve as a basis for future tools.

Tools to support the development and management of dynamic business models

Even though the literature frequently asks for IT-based tools for visualization, development, management, and evaluation of BMs (Veit et al. 2014), hardly any tools exist that consider the dynamic behavior of BMs. Terrenghi et al. (2017) provide an overview of the topic of BM management. Di Valentin et al. (2013) provide insights on how to build configuration and monitoring tools for BMs in the software industry. The studies that apply simulation models have built the basis for developing supporting tools. Yet, any tool for DBM has to allow for flexibility in a BM already during development and has to be applicable to users that do not have knowledge of simulation methods. These tools must recognize the need for flexibility in adapting DBMs in the future. Various strategic scenarios have to be incorporated, and the user must understand what kind of changes are possible, necessary, or permitted in the evolution of a BM. Furthermore, the tools should allow for experimentation with multiple settings and different options, to identify the underestimated, overlooked, or overrated factors and patterns that could be relevant in the future. Simulation-based tools help to reduce real-life experimentation in the development of BMs (Rong et al. 2018), which is costly and poses risks. Unlike real-life experiments, simulations can be performed ongoing, in a fraction of the time, and repeated, allowing for a greater number of experiments.

Developing respective tools will not only help to build long-lasting DBMs, but also support the management and evaluation of DBMs in the long run. Building on a unified taxonomy, it should be evaluated if and how the data of an organization's information systems, such as an ERP system, can be automatically assessed and analyzed. This would promote the concept of DBM to be an actual management tool. However, to do so, this unified taxonomy would need concrete and comparable metrics. Evaluations of other approaches, such as data-driven modeling, should be tested to provide a greater variety of fact-and metrics-based tools. An interesting approach by Valter et al. (2018) in a series of three papers experimented with deep learning methods in the context of BMI.

6 Future Research

Based on the analysis in this study, future research should consider the following aspects to drive the understanding, conceptualization and usage of DBMs (see Table 5).

Future Research on Dynamic Business Models
• Conceptualizing dynamic business models as living and complex systems • Foster the use of a harmonized taxonomy of dynamic business models • Understanding the complex interactions of the subcomponents of a dynamic business model and the influence of external triggers • Long-term and large scale empirical studies about the evolution of business models • Combination of modeling and simulation approaches (such as system dynamics) with suitable theoretical constructs (such as financial models, systemic thinking or scenario evaluation) • Development of practice-oriented tools for the development and management of DBM, based on simulation models and explorative and strategic methods • Data-driven modeling with a harmonized taxonomy, building on real-world data in organizations

Table 5. Future Research on Dynamic Business Models

Future research can employ a systemic perspective on DBM in order to conceptualize the construct. The development and use of a unified taxonomy can enable empirical studies on a large scale. It is important,

however, to note that past research on BM has frequently asked for this unified language, without substantial success. The evolution process of a BM should be studied in detail, applying various research perspectives and looking at a variety of cases. The comprehension of the interrelated components of a DBM is very important. Simulation approaches, especially system dynamics, are suitable to study this phenomenon. The suitability and usefulness of other simulation approaches, such as complex adaptive systems, should also be evaluated in the future. Based on this, the influence of external triggers on the components of a BM could be understood in more detail, enabling better decision-making and long-lasting BMs. New tools have to be developed, that use simulation models in the background, and are easily comprehensible by practitioners without profound knowledge of modeling or simulation methods. Rather, combining simulations with further theoretical constructs, such as systemic thinking and scenario evaluation, as well as with financial models, such as real-options theory, could provide tools to support the complexity of the DBM and to evaluate different strategic scenarios. In the long run, it should be tested how data from the information systems of organizations can be used within the models. Further, publicly available data, could be used for modeling and simulation.

7 Conclusion

The concept of BMs has been criticized by research and practice for having a too static perspective. To address this gap, this paper focused on improving the understanding of DBMs by performing a structured research study. We first provided an overview of relevant definitions related to the concept of DBM. Conducting a literature review, we identified 42 relevant sources from the literature, which are classified into 15 dimensions. Based on these dimensions, we achieved a classification of the streams of knowledge on DBMs in the literature. The results of this classification show that there are different approaches with varying focus on the topic of DBMs. Despite the usefulness of existing research, there still are a variety of research gaps to be tackled in the future. Especially, interactions of the components of a DBM should be studied in detail. Additionally, tools that allow evaluation of different strategic scenarios, with a systemic and detailed perspective on DBM and the nuanced changes among its components, are necessary. A combination of strategic methods with simulation approaches seems suitable and should be tested in the future. Further research should focus on empirical and long term studies to understand DBM in detail.

Our research may have several limitations. Despite the broad scope of the search query of the literature review, other relevant topics might remain hidden. Furthermore, a more detailed look at corresponding research streams, such as the study of ecosystem dynamics, might reveal additional insights. Additionally, the selection and classification of literature by nature is partly subjective.

Our work contributes to research by providing a broad overview of the topic of DBMs. By classifying related literature, we describe the most relevant research streams and show the shortcomings of existing research. In tackling the future research opportunities, as shown in Table 5, the concept of DBM will help to understand the evolution of a BM on a very detailed level. Based on this, tools to support practitioners to make better decision regarding their BM can be developed, allowing incorporation of different strategic options as well as heterogeneous influences. Thus, a DBM can reduce experimentation, help anticipate future developments, improve the management of risks within a BM, and in general, allow the design and management long-lasting BMs. Yet, hardly considered in the prior literature is the issue of finding an equilibrium between stability and flexibility of a DBM - a BM should be flexible enough to allow for change but offer some stability for the development of a company's activities (Cavalcante et al. 2011).

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Appendix B. An Analysis of Business Model Component Interrelations (P2)

6-22-2020

An Analysis of Business Model Component Interrelations

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Abstract

Innovative business models are crucial for a firm's competitive success. When adapting a business model, it is key to understand existing interrelations between its components, as a change in a single component can lead to various changes in other components. Furthermore, the influence of external triggers on components is crucial to understand the inherent dynamics caused by these interrelations. With this study, we gather, describe, and classify interrelations between business model components based on the existing literature. In research, these results can be used to model the inherent dynamics of business models. In practice, this knowledge helps to develop and maintain a stable business model by considering the found interrelations of its components. Furthermore, it supports the evaluation and implementation of changes in BMs. Moreover, we contribute to research on business model innovation, dynamic business models, and cognitive biases in the use of business models.

Keywords: *business model innovation, dynamic, interrelations, interdependencies, decision support*

Introduction

The business model concept is prevalent in scientific literature and companies continuously strive to develop new, innovative business models (BMs). When designing or innovating a BM, one typically aims to solve questions on how to create or enter new markets, what the right product and service offerings are, which ways of value capture are appropriate or how the proposed new model differs from competitors (Zott and Amit 2010) but does not focus on how the model will behave in the market (Demil and Lecocq 2010). Current research lacks insights into mid-and-long term occurrences of BM evolution (Bohnsack et al. 2014). Yet, as evidenced by theory and practice, a firm's BM is not a static construct, but it rather changes and has to be adapted continuously over time (Chesbrough and Rosenbloom 2002; Gerasymenko et al. 2015; Moellers et al. 2019; Wirtz et al. 2016).

When launching a new BM, various adaptations occur. McGrath even states that BMs "often cannot be fully anticipated in advance. Rather they must be learned over time" (McGrath 2010, p. 248), leading to a process of trial-and-error (Birkinshaw and Goddard 2009; Desyllas and Sako 2013). As components are interrelated, even small changes within one component lead to changes or the necessity of adaptation within another component (Bieger and Reinhold 2011). We refer to this phenomenon as inherent dynamics, which mainly occurs between the components a BM is constituted of (Cosenz and Noto 2018).

Despite existing extant literature on specific interrelations, no fully comprehensive overview exists. As of now, these interrelations are not sufficiently understood (Burkhart et al. 2011; Chen et al. 2019; Schaffer et al. 2019). Thus, the objective of this paper is to answer the following guiding research question: *What interrelations exist between business model components, and how are they characterized?*

Answering this question, we identify interrelations between business model components. For each interrelation, we specify the respective impact. The generated knowledge can be used to design new BMs as well as to support the implementation of changes in BMs (Gerasymenko et al. 2015), which improves performance in complex environments (Bock et al. 2012). At the same time, it helps to ensure the necessary tight coupling between the components (Al-Debei and Avison 2010; Demil and Lecocq 2010). This allows for understanding the complexity and inherent dynamic of a BM.

This paper contributes to research on BM innovation (BMI) and dynamic BMs, strengthening the BM as a theoretical construct. In detail, the results contribute toward the research stream of cognitive biases in the use of BMs (Martins et al. 2015), as decision-makers tend to get stuck in a specific path to BMI (Bohnsack et al. 2014). Managers often have cognitive biases in the direction a BM should evolve towards, and do not grasp the entity of complex interrelations leading to ill-informed decisions. If no transparency of the interrelations exists, the cognitive biases may lead to suboptimal decisions and in the long run may endanger the usefulness of the whole BM. Knowing these interrelations minders these biases. We contribute to research on BMI by fostering innovation by a transparent mapping of internal influences of the operating company, as well as external influences such as market conditions, technology progression, or customer demands onto the BM (Andries et al. 2013; Wirtz et al. 2016).

From a practical view, this research offers insights for entrepreneurs and decision-makers to develop more sustainable BMs while considering internal dependencies. Also, this knowledge allows to perceive opportunities due to the transformation of BMs as well as to prevent risks, which result from a specific constellation of components and external factors and fosters the entrepreneurial learning process. A BM should be flexible enough to allow changes, but at the same time offer stability for the development of a company's activities (Cavalcante et al. 2011), which can be evaluated based on the results. Lastly, a comprehensive representation of existing interrelations of a BM increases transparency and helps potential investors to evaluate the profitability.

The remainder of the paper is structured as follows: First, we introduce existing prior work. Next, we outline the applied methodology of our research, building on a literature review. Afterward, the results of the analysis are presented and their implications are discussed in detail. In the last section, we conclude the paper.

Extant Literature on Business Model Component Interrelations

There currently is no fully accepted definition of BMs in the literature (Cosenz and Noto 2018). Massa et al. (2017) have identified three basic interpretations of BMs: as attributes of real firms, as cognitive or linguistic schemas, and as formal conceptual representations of how an organization operates. Formal conceptual representations, as the third interpretation of BMs, are useful to understand and frame the complexity of BMs (Cosenz and Noto 2018; Sterman 2000). Building on this third interpretation of BMs, we adhere to the understanding of BMs by Teece (2010) emphasizing on value creation, value delivery, and value capture. We use the extended definition of dynamic BMs: "A dynamic business model is a complex system of interrelated subcomponents of the value creation, delivery, and capture mechanisms, which is interacting with heterogeneous internal and external influences leading to the evolution of its components and the system itself" (Schaffer et al. 2019).

Interpreting BMs as dynamic and complex systems, Demil and Lecoqc (2010) propose "dynamic consistency" as a firm's capability of anticipating and reacting to sequences of voluntary and emerging change, sustaining a BM's performance while adapting it. For preserving performance, the literature emphasizes the necessity to adopt a holistic approach, which incorporates an understanding of existing interrelations between BM components (Baden-Fuller and Mangematin 2013; Casadesus-Masanell and Ricart 2010). Additionally, Casadesus-Masanell and Ricart (2010) stress that existing interrelations in BMs can produce virtuous cycles, i.e. reinforcing feedback loops that would fortify parts of the model

over time. These virtuous cycles can be critical factors in successful BM operation and various aspects of managing BMs can strengthen their implications (Casadesus-Masanell and Ricart 2010), supporting a holistic approach.

Extant literature researched the influence of particular effects on specific components. Gerasymenko et al. (2015) provide research about the effect of venture capital funding on the performance of BMs. In their study, they identified a positive effect of involving an outside CEO into a young venture, i.e. a change in the resources of the BM. Lehoux et al. (2014) perform a longitudinal case study to understand the influence between BM design and technology design, based on insights from three health-technology spin-offs. Davies and Doherty (2019) draw on sustainable business model research to perform a case study with a BM responding to changes in the market as well as the societal environment, providing insights towards changing of value capture objectives and diversifying value creation activities. Visnjic and van Looy (2013) identified a positive impact of the availability of services onto the financial model of manufacturing companies. Krumeich et al. (2013) researched structural relations between BM components, providing an overview of existing interrelations. However, as different components are grouped in this research, it is difficult to understand the interrelations in detail to make use of them in practice.

To map and understand the interrelations between BM components in detail, it is first necessary to select a suitable framework. As mentioned, this study builds on the interpretation of BMs as a formal conceptual representation of how an organization functions, as it is, for example, the Business Model Canvas. In this study, we use the business model component framework by Krumeich et al. (2012). This framework emphasizes on value creation, delivery, and capture and, at the same time, provides great detail, describing comprehensively the constituting components and extending the three value dimensions by a cooperation model and a financial model. In total, the framework consists of 20 components, as such allowing to describe a BM in more detail compared to e.g. the Business Model Canvas, and is depicted in Figure 1.

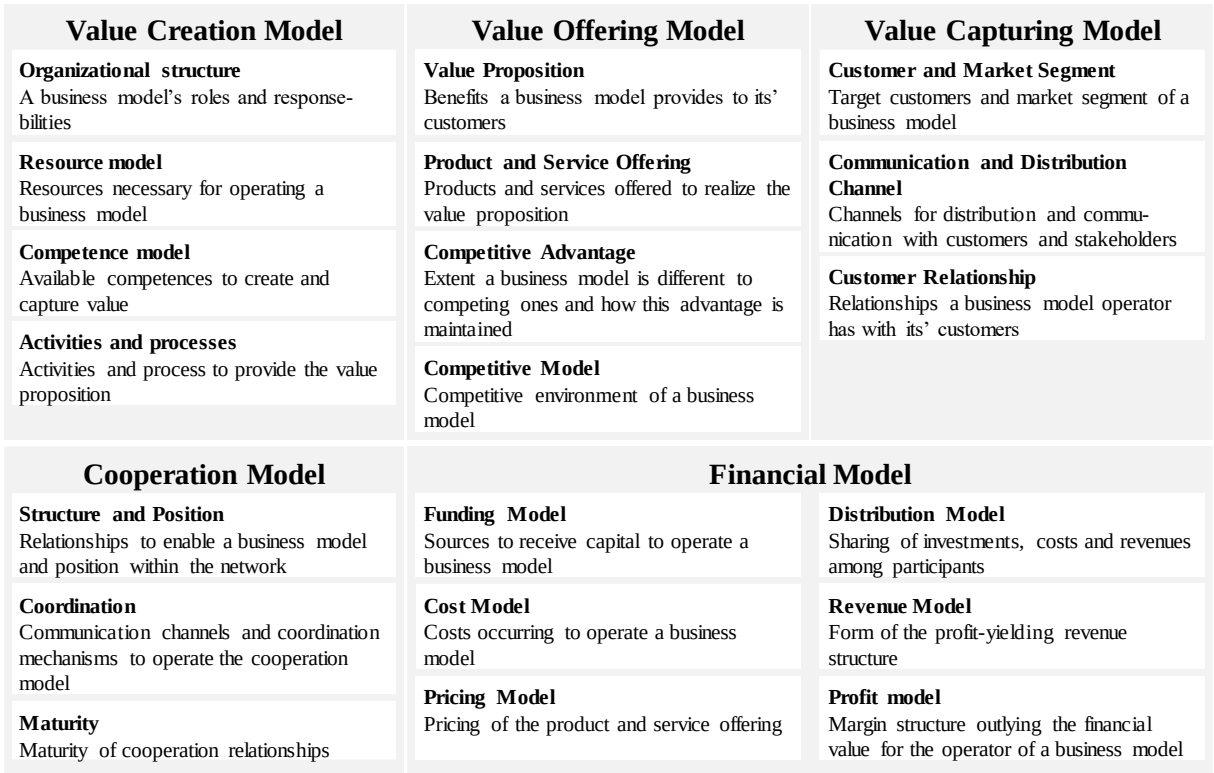

Figure 1. Business Model Component Framework by Krumeich et al. (2012)

Research Approach

We conducted a systematic literature review following the guidelines of Webster and Watson (2002). We build a broad foundation of scientific literature using the databases Scopus and EBSCOhost. For conference papers, we used the AIS digital library. As sources, the Financial Times 50, the IS Basket of 8 (if not included in the Financial Times 50), as well as the top IS conferences (HICCS, ICIS, ECIS, AMCIS, PACIS) were reviewed to guarantee the use of high-quality literature and at the same time taking into account the cross-disciplinary nature of the BM concept. The journal Longe Range Planning was included in the sources as well, as it provides various important papers in the context of BMs.

Within these sources, we looked for case studies dealing with the concept of (digital) BMs as well as papers providing or elaborating on interrelations. To do so, we used the following two search streams performing a title-abstract-keyword search in the databases: 1) ["business model" AND (depend* OR interrelat* OR evol* OR dynamic*)]; 2) ["business model" AND case]. After eliminating double hits between the search streams, this provided 139 hits in journals and additionally 147 conference papers. Out of those, 33 have been deemed relevant, as they dealt with the BM as the central concept. We focused on concrete cases to ensure an empirical foundation of the respective insights. Additionally, papers elaborating on interrelations were included. Performing a forward-backward search, the final sample used for coding consisted of 36 papers.

We applied procedures from grounded theory, according to Corbin and Strauss (1990), for coding. We used the component-based BM framework by Krumeich et al. (2012) (see Figure 1) to map the interrelations within a matrix. In the matrix, we summarized the components competitive advantage and competitive model into a single component. To understand the uncertainty and complexity that characterize today's markets, external factors influencing the BM should be taken into account as well (Boons and Lüdeke-Freund 2013; Demil and Lecocq 2010). Thus, we added "external" as an additional component in the applied framework to enhance a detailed understanding of the influence of external triggers on specific components, resulting in a 20x20 matrix.

The authors coded the first ten papers independently and afterward compared and discussed the results to reach conclusive coding. The remaining 26 papers have been coded independently by the authors. Differences have been resolved through discussion of the respective coding results and by obtaining additional information about the cases, if available, in a final round to reduce inaccuracy.

We coded three different kinds of interrelations: "+" is a positive or direct relationship, meaning a component A has a positive influence on component B. Positive describes if the measure of component A grows, in the specific case also the measure of component B grows. For example, if more funds can be generated due to new capital sources (increase in component A: funding model), this may lead to a positive effect on available resources, as more money for external know-how, training or new employees is available (increase in component B: resource model). "-" in term reflects an indirect or negative relationship, meaning if the measure of component A grows, the measure of component B decreases. "N/A" is used for interrelations, which have been found within the specific research, but it is not fully clear what the nature of this interrelation is. This notification is used throughout Figures 2-5.

Results of the Analysis: Interrelations between Business Model Components

In Figure 2 all interrelations between components found within our sample are displayed. A row in the matrix shows the influence a specific component has on other components, e.g. the first-row organizational structure displays what components are affected by changes in the organizational structure. A column, in turn, allows understanding which components affect a specific component of interest. For example, the column funding model displays the entity of components affecting the funding model found within our sample.

The analysis revealed several interrelations between BM components, which occurred more often than the remaining interrelations within our literature sample. The components of value proposition as well as product and service offering show the highest number of interrelations. Additionally, the matrix shows a high influence of other components onto the resource model. Probably more surprising, within

our sample we found several unilateral influences of the value capturing model onto the financial model, meaning these interrelations are not mutual, but rather we discovered a high influence of the value capturing model onto the financial model, but not vice versa. Within the sample, we furthermore only found two cases in which the financial model influenced the cooperation model, while the cooperation model, in turn, influences the financial model in a variety of cases.

In the following, the focal points of our analysis are the most interesting insights we found during the review. These are spots in the matrix which show a high occurrence of interrelations. First, we focus on the quadrants of the matrix in Figure 2, which display models compromising several components. Afterward, we exemplary discuss the interrelations of specific BM components. We choose to focus on these interrelations, as they show a high number of influences based on the matrix, and are relevant for digital BMs.

Interrelations between the Value Creation Model and Value Capturing Model

The value creation model describes aspects regarding the value creation within organizations, while the value capturing model, in turn, determines which customer segments are being addressed by which ways and how these relationships are organized (Krumeich et al. 2012). Understanding interrelations between those two models is relevant to gather the right competencies and resources as well as to put the right activities in place to create and maintain a suitable approach to communication with the addressed customer segments.

Interestingly, only few interrelations have been found between the models of value creation and value capture. Within our sample, the value capture model is only influenced within the components customer and market segment as well as customer relationship, which both show a positive dependence of the activities and processes as well as of the resource model. This implies the activities and processes, undertaken to enhance the BM positively, influence the relationship with the customers, and allow addressing new customer segments. This should be taken into consideration especially for digital BMs, which build on digital means of customer engagement. In turn, if activities and processes are performed which might be perceived as "negative", for example diminishing processes such as customer support, a negative influence on the customer and market segment as well as the customer relationship is observed.

Interrelations between the Value Creation Model and Value Offering Model

The value offering model specifies the value proposition a BM aims to express and the products and services offered to do so. The value proposition is considered to be the key component of a BM (Krumeich et al. 2012). Understanding interrelations between the value creation model and value offering model helps to ensure the right use of resources and activities to create the value proposition and helps to understand how the organizational structure supports that creation or might be affected by it.

The value offering model is the one most impacted by other components. Especially between the value creation model and the value offering model, a variety of interrelations occur between its respective components, with most of these being mutual. In general, the value proposition is positively influenced by the components of the value creation model. In turn, within our sample, positive relations of the value proposition to the resource model and activities and processes are found, but a negative influence onto the organizational structure. In the case presented by Davies and Doherty (2019) about a fair-trade social enterprise selling coffee, Cafédirect, a change in the value proposition led to the change in leadership positions, the creation of new management positions as well as a revised, more complex and more costly organizational structure.

		Value Creation Model				Value Offering Model			Value Capturing Model			Cooperation Model			Financial Model						
		Organizational Structure	Resource Model	Competence Model	Activites and Processes	Value Proposition	Product and Service Offering	Competitive Model (& Advantage)	Customer and Market Segment	Communication & Distribution Channel	Customer Relationship	Structure and Position	Coordination	Maturity	Funding Model	Distribution Model	Cost Model	Pricing Model	Revenue Model	Profit Model	External
Value Creation Model	Organizational Structure			+(Kranz et al. 2016)	+(Hoßbach 2015)							+(Sitoh et al. 2014)		-(Ojala 2015)	+(Bohnsack et al. 2014); +(Bolton/ Hannon 2016)						
	Resource Model	N/A(Bohnsack et al. 2014)		+(Gersymenko et al. 2015)	-(Davies/Doherty 2018); +(Bohnsack et al. 2014); +(Antonopoulou et al. 2014); +(Sitoh et al. 2014); +(Naous et al. 2017); +(Singh et al. 2011) +(Snihur et al. 2018)	+(Snihur et al. 2018); +(Deodhar et al. 2012); +(Björkdahl 2009); +(Singh et al. 2011)	-(Ojala 2015); +(Lehoux et al. 2014)		+(Singh et al. 2011)		+ (Sitoh et al. 2014);+ (Visnjic/ Van Looy 2013)	+(Gersymenko et al. 2015)	+(Gersymenko et al. 2015)	+(Snihur et al. 2018)	-(Ojala 2015); +(Bohnsack et al. 2014)		+(Snihur et al. 2018); -(Bohnsack et al. 2014); +(Antonopoulou et al. 2014)		+(Deubener et al. 2016)		
	Compentence Model				N/A(Bohnsack et al. 2014); +(Desyllas/Sako 2013); +(Mason/Leek 2008)	+(Björkdahl 2009); +(Feller et al. 2011); +(D'Angelo/Benassi 2015)		+(Singh et al. 2011)				+(Mason/Leek 2008)		+(Mason/ Leek 2008)	+(D'Angelo/Benassi 2015)				+(Chesbrough 2007); +(Björkdahl 2009)		
	Activites and Processes	N/A(Bolton/ Hannon 2016)	+(Zolnowski et al. 2016)			+(Davies/Doherty 2018); +(Deodhar et al. 2012); +(Antonopoulou et al. 2014)	+(Andires et al. 2013); +(Zolnowski et al. 2016); +(Khuntia et al. 2017)		+(Chong et al. 2019)		+(Doedhar et al. 2012); + (Sitoh et al. 2014)						+(Bolton/Hannon 2016); +(Desyllas/Sako 2013); +(Björkdahl 2009); +(Zolnowski et al. 2016); +(Singh et al. 2011)		+(Deubener et al. 2016); +(Khuntia et al. 2017)		
Value Offering Model	Value Proposition	-(Davies/ Doherty 2018)	+(Davies/Doherty 2018)		+(Davies/Doherty 2018); +(Andries et al. 2013); N/A (Freudenreich et al. 2019)		N/A(Davies/Doherty 2018); N/A(Bohnsack et al. 2014)	+(Snihur et al. 2018); +(Freudenreich et al. 2019)	+(Davies/Doherty 2018); +(Desyllas/Sako 2013)	+(Davies/Doherty 2018); N/A(Zolnowski et al. 2016)	N/A(Zolnowski et al. 2016)			+(Ojala 2015); +(Davies/ Doherty 2018)		N/A(Bohnsack et al. 2014)	+(Desyllas/Sako 2013)				
	Product and Service Offering		+(Bohnsack et al. 2014); N/A(Desyllas/Sako 2013)	N/A(Hoßbach 2015)	N/A(Desyllas/Sako 2013); +(Khuntia et al. 2017)	+(Voss et al. 2008); +(Zolnowski et al. 2016); +(Naous et al. 2017)		+(Lehoux et al. 2014); +(Voss et al. 2008)	+(Lehoux et al. 2014); +(Khuntia et al. 2017); +(Chong et al. 2019)	+(Ojala 2015); +(Amit/Zott 2001); N/A(Desyllas/Sako 2013); +(Hoßbach 2015)	+(Visnjic/Van Looy 2013)	N/A(Desyllas/ Sako 2013)		N/A(Ojala 2015); +(Khuntia et al. 2017)			-(Bohnsack et al. 2014); +(Desyllas/Sako 2013)		+(Khuntia et al. 2017); +(Bohnsack et al. 2014); +(Desyllas/Sako 2013); +(D'Angelo/Benassi 2015); -(Khuntia et al. 2017); +(Wendler et al. 2017)		N/A(Deodhar et al. 2012)
	Competitive Model (& Advantage)		+(Desyllas/Sako 2013)			+(Björkdahl 2009)			+(Snihur et al. 2018)												
Value Capturing Model	Customer and Market Segment	+(Andries et al. 2013)				N/A(Bohnsack et al. 2014); N/A(Freudenreich et al. 2019); +(Naous et al. 2017)	N/A(Ojala 2015); +(Chong et al. 2019)			+(Lehoux et al. 2014); +(Lee/Li 2016)					-(Ojala 2015); +(Wendler et al. 2017)	+(Deodhar et al. 2012)	+(Amit/Zott 2001)	N/A(Desyllas/Sako 2013); N/A(Hoßbach 2015)	N/A(Rai/Tang 2014); N/A(Niculescu/Wu 2014); +(Wendler et al. 2017)		
	Communication & Distribution Channel						+(Amit/Zott 2001)										+(Amit/Zott 2001)		-(Amit/Zott 2001); N/A (Niculescu/Wu 2014)		
	Customer Relationship				N/A(Deodhar et al. 2012); +(Bonaccorsi et al. 2006)		+(Voss et al. 2008)					+(Bolton/ Hannon 2016)			+(Rai/Tang 2014)	+(Deodhar et al. 2012)	+(Amit/Zott 2001)	N/A(Ojala 2015)	+(Amit/Zott 2001); +(Deodhar et al. 2012)		
Cooperation Model	Structure and Position		+(Nahous et al. 2017)	+(Amit/Zott 2001); +(Rai/Tang 2014); +(Chesbrough 2007); +(Feller et al. 2011); +(Mason/Leek 2008)	+(Mason/Leek 2008)	+(Feller et al. 2011); +(D'Angelo/Benassi 2015); +(Freudenreich et al. 2019); +(Naous et al. 2017)	+(D'Angelo/Benassi 2015)	+(Chong et al. 2019); +(Desyllas/ Sako 2013)			+(Nahous et al. 2017)				+(Khuntia et al. 2017); +(Wendler et al. 2017)		-(Bohnsack et al. 2014); +(Chesbrough 2007)		+(Chesbrough 2007); +(Wendler et al. 2017)		
	Coordination			+(Feller et al. 2011)	+(Feller et al. 2011)									+(Amit/Zott 2001)	+(Feller et al. 2011)		+(Amit/Zott 2001); +(Chesbrough 2007); +/-(Feller et al. 2011); +(D'Angelo/Benassi 2015)				
	Maturity		+(Ojala 2015); +(Lehoux et al. 2014)	+(Mason/Leek 2008)			+(Lehoux et al. 2014); +(Khuntia et al. 2017)	+(Snihur et al. 2018)	+(Lehoux et al. 2014)	+(Ojala 2015); +(Davies/Doherty 2018)	-(Ojala 2015)				+(Davies/Doherty 2018); N/A(Bohnsack et al. 2014)		+(Mason/Leek 2008)	N/A(Ojala 2015)	+(Ojala 2015); N/A(Bohnsack et al. 2014)		
Financial Model	Funding Model		+(Gerasymenko et al. 2015); + (Sitoh et al. 2014)	+(Gerasymenko et al. 2015)	N/A(Andries et al. 2013)		-(Lehoux et al. 2014)							N/A(Lehoux et al. 2014)							
	Distribution Model		N/A(Lehoux et al. 2014)																		
	Cost Model		-(Lehoux et al. 2014)		-(Antonopoulou et al. 2014)		-(Antonopoulou et al. 2014)					N/A(Hoßbach 2015)									
	Pricing Model					+/-(Björkdahl 2009)			N/A(Singh et al. 2011)										-(Bohnsack et al. 2014); +/-(Kranz et al. 2016); -(Singh et al. 2011)		
	Revenue Model		-(Lehoux et al. 2014)			+(Desyllas/Sako 2013); +(Antonopoulou et al. 2014); +(Niculescu/Wu 2014); +(Deubener et al. 2016)			N/A(Niculescu/Wu 2014)							+(Deodhar et al. 2012)	-(Lehoux et al. 2014)			N/A(Khuntia et al. 2017); N/A(Visnjic/Van Looy 2013)	
	Profit Model																				
External				N/A(Snihur et al. 2018)	+(Davies/Doherty 2018)	N/A(Chong et al. 2019); N/A(Bohnsack et al. 2014)	N/A(Ojala 2015); N/A(Lehoux et al. 2014); +(Kunthia et al. 2017); N/A(Deodhar et al. 2012); -/N/A(Bonaccorsi et al. 2006)	-(Andries et al. 2013); -(Björkdahl 2009)		N/A(Bohnsack et al. 2014)					-(Ojala 2015); +(Bolton/Hannon 2016); -(Freudenreich et al. 2019); +(Andries et al. 2017)			-(Bonaccorsi et al. 2006)	+(Kunthia et al. 2017)		

Figure 2. Business model component interrelations

Influences on the Financial Model

The financial model determines the financial viability of a BM from an economic point of view (Krumeich et al. 2012). Understanding which components influence the financial-based components helps to reduce risks and creates financial transparency.

The components of the financial model show a high dependency on other components within our sample. The most influences onto the financial model can be found from the value capturing model and the cooperation model. In particular, the financial model is highly influenced by the components customer and market segment and customer relationship. While the influence of the customer and market segment onto the components of the financial model within our sample is rather heterogeneous, the customer relationship mostly positively influences those components. In the case by Deodhar et al. (2012), presenting a hybrid BM of open-source software, Openbravo ERP, existing customer relationships led to the creation of new revenue sources (Deodhar et al., 2012). Importantly to note, the nature and intensity of these interrelations differ according to the respective revenue model (e.g. one-time sales vs. pay-per-use), a relevant aspect for digital BMs building on recurring revenue sources.

The financial model depends on the product and service offering as well as the value proposition itself. Nowadays, BMs increasingly offer services instead of products (referred to as "servitization", see for example Weking et al. 2018), which implies different developments onto the financial model, in concrete onto the profitability, which should be taken into consideration. Visnjic and van Looy (2013) find an overall positive impact of the availability of services onto the financial model, which however is not linear and depends heavily on the number and labor-intensity of services offered.

In the following, we describe the interrelations of specific components with other components.

Interrelations of the Component Funding Model

The funding model describes the sources of capital to operate a BM (Krumeich et al. 2012). In practice, it is necessary to understand interrelations of the funding model to improve strategies to receive funding (mainly in the case of venture capital) or to ensure which components not to change if the current funding model should not be adjusted. Within our sample, we found the following five components that are directly influenced by the funding model: resource model, competence model, activities and process, product and service offering, and maturity. Regarding external funding, not only a financial impact of external funding is observed. Rather, external funding can deliver additional benefits to the existing competencies and resources or the existing network. Figure 3 displays the interrelations of the component funding model found in the literature.

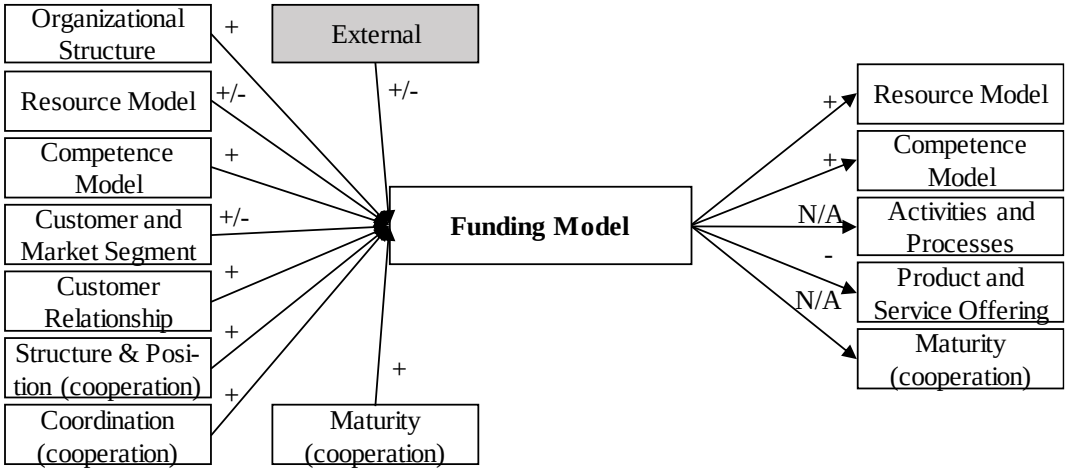

Figure 3. Interrelations of the component Funding Model

Interrelations of the Component Organizational Structure

The organizational structure can be understood as the underlying structure to enable a BM. It defines the BM's roles and responsibilities for implementing the activities and processes as well as the underlying resource model and competence model (Krumeich et al. 2012). Mangers change structures to initiate innovation and to address opportunities (Bock et al. 2012). At the same time, it is important to consider if and how the organizational structure is affected by changes when updating a BM architecture. Within our sample, the four components resource model, activities and processes, value proposition, and customer and market segment directly influence the structure (see Figure 4). For example, addressing a new customer segment might imply necessary changes in the organizational structure. It then should be evaluated if the expected benefits of a new customer segment outmatch the costs (in terms of resources as well as stability in the organization) of adapting the organizational structure that enables the BM.

In turn, the organizational structure directly influences the competence model, the activities and processes, the structure and position in the network, the maturity of the network as well as the funding model within our sample. For example, this implies a change in the organizational structure might be beneficial to create or receive funding. This could be due to a flatter hierarchy allowing a lower cost structure, or potential shareholders might perceive a revised organizational structure positively.

Figure 4. Interrelations of the component Organizational Structure

Influences on the Components Value Proposition and Product and Service Offering

In the center of a BM is the value offering model, which is expressed by its key components value proposition and product and service offering. The value proposition describes the benefits a BM provides to its' customers. A BM needs to express a clear and beneficial value proposition, which is executed to a large extend by the product and service offering (Krumeich et al. 2012). Knowledge about interrelations of these two components allows focusing on the relevant elements when developing a new value proposition or when testing how changes influence the product and service offering.

Surprisingly, in our sample, we only found four components having a direct influence on both, the value proposition and the product and service offering: the resource model, the activities and processes, the structure and position within the network as well as the customer and market segment (see Figure 5). Interestingly, we found several studies showing a positive relationship of the network directly onto the value proposition, while one might expect the network to have a positive influence onto the BM in general, but not directly onto the perceived value proposition. Additionally, we found external factors influencing these two components. Yet, the value proposition, as well as the product and service offering, are directly interrelated, and both components are affected individually by a variety of other components.

In financial terms, the value proposition is directly influenced by the revenue model and pricing model, as those two components are perceived by the customers of a BM. This expresses that the concrete form of the revenue model and pricing structure directly determines the expected benefit from a customer's perspective and influences his willingness to pay (Johnson et al. 2008), especially for digital services. For example in the case of so-called "Pay-as-your-drive" auto insurance presented by Desyllas and Sako

(2013), a digitally enabled BM, a revenue model with a pay-per-use mechanism is positively received by its' customers and provides a novel value proposition, while the underlying product and service offering stays the same, i.e. providing car insurance. At the same time, the funding model only interrelates with the product and service offering but has no direct impact on the value proposition itself.

Regarding the customers and the relation with them, interrelations of customer and market segment onto both, the value proposition as well as the product and service offering have been found. However, within our sample, the customer relationship only influences the product and service offering, but not directly the value proposition itself. In the case of a toy retailer presented by Voss et al. (2008), a good relationship with customers and the possibility for customers to test innovations directly influenced the offered products and services.

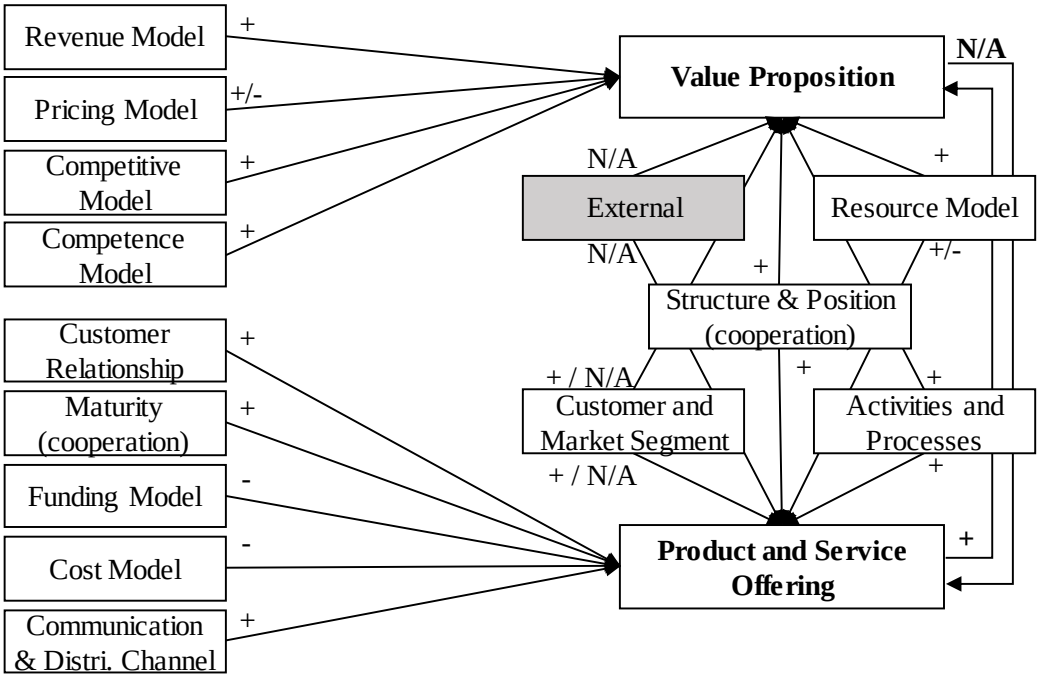

Figure 5. Influences onto the components Value Proposition and Product and Service Offering

Discussion and Implications

The results of this study present different learnings in the context of BMs. First, we identify and characterize existing interrelations between BM components based on prior literature. Knowledge of these interrelations enhances research on BM innovation and dynamic BMs, as knowledge about the interrelations is necessary when updating a BM architecture. Second, we show how interrelations of a specific BM can be mapped, increasing transparency about a BM, which allows more informed decision making and ensures considering all relevant influences while creating strategic flexibility (see Bock et al. 2012) within the BM.

Third, we show how to apply the learnings of the interrelations to study specific components in detail (e.g. "what might influence our funding model"). Specific components, as well as a whole BM, can be evaluated towards risks and opportunities, robustness, cost of changes, and adaptability. A balance between the components should be kept when innovating a BM (Al-Debei and Avison 2010). Explicitly expressing the existing interrelations allows to understand which components of a BM are affected during the innovation process, thus managing to create or keep this balance. At the same time, questions of risk and robustness of a BM can be evaluated, especially considering unconscious changes induced by various influences. By mapping the interrelations of a specific component, it becomes clear if and how this component is affected by other components. If high uncertainty within a specific component exists, e.g. the existing resources, its' influence onto further components can be evaluated and possible consequences are made transparent. On the other hand, if a company, for example, thinks about

changing its' organizational structure, the decision-makers can evaluate if the BM will be affected, and if so, in which components. In that sense, the robustness of a BM (see Haaker et al. 2017) can be evaluated and provides means of a risk-avoidance strategy. Understanding the impact of changes in one component onto other components furthermore enables to understand the cost of changes. It becomes imminent if a rather minor change implies substantial changes within the remaining components of the respective BM, and it allows to evaluate qualitatively beforehand what kind of resources will be necessary. When developing a BM, one can also use the interrelations to ensure the adaptability of the model, as various adaptions are necessary when launching a new BM. As such, knowledge about interrelations provides decision support and is especially helpful to design digitally-enabled BMs.

Our research is subject to certain limitations. Performing a cross-disciplinary review, we aimed to look at the phenomena under study from different perspectives. Yet, relevant prior studies might remain hidden due to the selection of sources and databases as well as the applied search streams. Additionally, coding is always party subjective. The applied framework consisting of 20 components provides a high level of detail. Yet, it can be challenging to code empirical BMs into this framework. Even though an independent coding process occurred to minder inconclusive coding, this limitation cannot be fully resolved. Considering Figure 2, one might wonder about empty spots within the matrix, showing the absence of interrelations between components, or in some cases even of whole models. Empirical research is necessary to validate if these empty spots exist due to the selection of sources, the process of coding, or if no interrelations are existing between these components. At the same time, most organizations operate several, sometimes complementing or competing BMs (often referred to as "ambidextrous challenge" in the case of competing BMs, see for example Hoßbach 2015), which should be considered when evaluating interrelations of a BM, but it is not reflected in the applied framework. The research of Hoßbach (2015) provides a detailed study of competing BMs. Lastly, the emotional attachment of decision-makers, as well as structural inertia of organizations inherent in decision making and BMI, is not reflected as well, even though these results help to mitigate this inertia.

These results enhance research on BM innovation as well as on dynamic BMs. They strengthen the BM as a theoretical construct and contribute to calls for research (Massa et al. 2017) in the following ways. First, the literature-based relationships among different business model components generate an initial model towards a theory of BMI and dynamics. It reveals structures of internal interdependencies and possible changes within a BM during its innovation. The models expose possible internal dynamics within a BM and, hence contribute towards an initial theoretical model. Such a theoretical model increases our understanding of risk management, adaptability, and robustness of BMs as well as their dynamics and changes. Clear contributions can be found in the emerging context of sustainable BMs. The field of sustainable BMs explores how organizations adapt their BM to address the creation of economic, social, and environmental benefits (Bocken et al. 2014; Davies and Doherty 2019). Knowledge about these interrelations helps to create a balance between the different forms of value creation and, thus, enhances research on sustainable BMs. We further see this review as a first step and foundation for future research to empirically explore these interrelationships.

Applying the interrelations within organizational context furthermore enhances research for organizations under change. If an organization is in a process of transformation, the influence of different changes of the organization happening over time, for example rethinking the organizational structure or replacing an existing manual process with automated workflows, can be directly mapped onto the BM, improving decision making. Additionally, transparency about the interrelations helps to optimize specific components, such as the funding model, the cooperation model, or the resource model. At the same time it minders cognitive biases and inertia of decision-makers (see for example Lee and Li 2016). As such, organizations can analyze in BMI projects which implications the adjustment propose onto the whole model, and which further changes might be necessary. This improves decision making and supports opportunity discovery, diminishing cognitive biases, and fostering a strategy learning process (Cosenz and Noto 2018). Also, the comprehensive representation of interrelations of a BM helps to evaluate the profitability for investors potentially funding the business (Chan and Park 2015).

Conclusion and Future Research

This paper has provided a cross-disciplinary review to identify interrelations between BM components. The discovered interrelations have been mapped onto an existing framework and evaluated if the specific interrelation has a positive or negative influence on the respective component. For exemplary components, the various dependencies were described in detail. We found a high number of interrelations affecting the value proposition and product and service offering of a BM. Surprisingly, we only found few dependencies of the financial model onto the value offering model, while vice versa the value offering model is heavily affecting the different financial components of a BM.

Future research should focus on empirical studies to extend these interrelations. For example, we found few dependencies of the financial model onto the value offering model, while vice versa the value offering model is strongly influencing the different financial components of a BM. This model can be complemented to reach an exhaustive description of the phenomena, and finally, a comprehensive model of all components. Additionally, these qualitative interrelations can be partly put in numbers, taking into consideration industry-specifics and further contextualizing factors. This research builds an initial model of theory on how BM components influence each other. Future empirical research can build on this model to evaluate the relative intensity of interrelations and contribute towards a theory of BMI and dynamics. This allows studying mid-and long term occurrences of BM evolution. The overview and description of interrelations enable the creation and improvement of tools in the field of BMI and dynamic BMs as well as in the research stream of sustainable BMs. Based on the interrelations, future research can develop decision support metrics in the context of BMs to help decision-makers comprehend and advance from these metrics when developing a new BM. To do so, industry or case-specific empirical research is suitable to build up a set of generic, but contextualized interrelations (for example for subscription-BMs).

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Appendix C. From Specialization to Platformization: Business Model Evolution in the Case of ServiceNow (P3)

6-14-2021

FROM SPECIALIZATION TO PLATFORMIZATION: BUSINESS MODEL EVOLUTION IN THE CASE OF SERVICENOW

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FROM SPECIALIZATION TO PLATFORMIZATION: BUSINESS MODEL EVOLUTION IN THE CASE OF SERVICENOW

Research paper

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Abstract

Currently, platform-based business models are most successful regarding revenue growth and market shares. However, the stepwise evolution of organizations' business models towards multi-sided platforms is not fully understood. Therefore, we conduct a longitudinal case study on the IT organization *ServiceNow*. Based on publicly available data, we build on research on business model evolution, platform emergence, and platform ecosystems to analyze the evolution of ServiceNow's business model between 2004-2020. We derive four distinct mechanisms comprising continuous value proposition extension and enablement of value co-creation. These are enabled by opening towards partners and iteratively addressing new customer segments. We contribute to research on business model evolution with insights on the evolution towards platform business models. Besides, we complement the perspective of platform emergence by a nuanced business model view, bridging these two literature streams. Practitioners benefit from the mechanisms to guide their business model evolution towards a multi-sided platform business model.

Keywords: Business Model Evolution, Multi-sided Platforms, Ecosystem, Value Co-Creation, Case Study

1 Introduction

Dynamic markets and fast-changing requirements are demanding for organizations. To remain competitive, companies have to continuously adapt their business models (BMs). The likes of Microsoft and Amazon successfully adapted their BM towards cloud and payment services. Zoom, a video communication technology provider mainly addressing corporate clients paying for their services, quickly reacted during the COVID-19 pandemic and offered their services for free to various customer segments around the world, such as educators. This drove its popularity and lead to a more than nine-fold increase of its company value within 10 months. In turn, organizations unable to change their BM fail to survive (Antero et al. 2013) or lose strong market positions, as was the case for Yahoo and Nokia, whose BM evolution did not match the market's demand. Collaborative approaches are one possible solution and allow the agility to strive in this competitive environment: The most valuable companies have digital platform-based BMs (Cusumano et al. 2019; Cusumano et al. 2020). Yet, many companies fail in the transition to platforms, posing a problem for them, as strong growth rates and the trend towards monopolization allowed by these models are then taken over by competitors (Cusumano et al. 2020).

Platform BMs change how products and services are produced and consumed by different platform sides, giving rise to multi-sided markets (Hein et al. 2019a). They rely on the idea that value is co-created among different groups of actors, such as users and autonomous developers (Gawer and Cusumano 2014; Tiwana et al. 2010). Successfully building a multi-sided platform BM is a highly challenging task, as these models propose a higher complexity compared to "traditional BM" such as product sales or licensing (Giessmann and Legner 2016). Successful platform BM can achieve high growth and offer large value capture potential for the owner. Existing literature elaborates on how these multi-sided platforms function (Hein et al. 2019a) and how they evolve based on design, governance, and environmental dynamics (Staykova and Damsgaard 2017; Tiwana et al. 2010). However, these studies focus on the evolution once the platform has been defined, ignoring the crucial steps in the evolution of a traditional BM preceding this stage. BM evolution describes a fine-tuning process of "voluntary and emergent changes in and between permanently linked core components [of a BM]" (Demil and Lecocq 2010). BM research studied evolution on organizational level (Antero et al. 2013; Davies and Doherty 2019; Demil and Lecocq 2010; Sosna et al. 2010), as well as on industry level (Banda et al. 2018; Bohnsack et al. 2014; Vaccaro and Cohn 2004). The studies on the organizational level show from an internal perspective how BMs evolve. Strategy literature like Porter's Five Forces (Porter 1980, 2008) or the Resource-based View (Barney 1991) focus on value creation and capture in a focal firm. Using the BM as a lens on platform emergence allows incorporating partners and third parties into the evolution of the value creation and capture mechanisms (Lanzolla and Markides 2020; Massa et al. 2017). Multi-sided platforms BMs rely on opening the value creation processes and leverage external knowledge sources. As such, they provide a challenging, but fruitful opportunity to provide detailed insights on BM evolution.

Addressing this void, we focus on the question: *How does a firm evolve its linear business model towards a multi-sided platform*? Using the BM as a framework to analyze the evolution offers the advantage to integrate external influences with internal properties of an organization, reflected in the value creation and capture mechanisms (Hedman and Kalling 2003; Teece 2010). The understanding of BM evolution to multi-sided platforms is valuable to (i) enhance research on BM evolution with an external view of opening value creation and leveraging external knowledge sources and, (ii) complement the perspective of platform emergence by a nuanced BM perspective. We apply a theoretical framework based on the Business Model Canvas to study the evolution of an organization whose BM successfully evolved towards a multi-sided platform (Yin 2018): the US software company *ServiceNow*. Within 16 years, the organization iteratively developed from a small and specialized IT software provider to a platform enterprise. As BMs are inherently based on software and embedded in dynamic settings (Alt 2020), this provides a suitable case to study the phenomenon. We develop a process theory of how a continuous extension of value proposition combined with iterative changes of further BM components evolves closed BMs to become open and subsequently multi-sided platforms.

With this study, we contribute to research by bridging literature about platform emergence, platform launch strategies, and BM evolution. We provide novel results on BM evolution in the context of multi-sided platforms. The results provide a nuanced view on platform emergence on the level of the BM, allowing practitioners to better address the problem of platform development by showing how they can evolve their existing BM towards multi-sided platforms.

2 Business Model Evolution and the Emergence of Platforms

The logic of BMs has become critical for business success (Veit et al. 2014). The concept's tangibility in practice increases its relevance in research, offering a novel lens to develop new theoretical insights in strategy (Bigelow and Barney 2020; Lanzolla and Markides 2020). A BM can be understood as an activity system changing dynamically, constituted of independent activities of a firm and its partners to create value (Arbussa et al. 2017; Zott and Amit 2010). The so-called Business Model Canvas is one of few widely adopted representations of BMs, which we use as a framework within this study (Massa et al. 2017). It consists of nine components: *Value proposition, key partners, key activities, key resources, customer relationships, customer segments, channels, cost structure, revenue streams* (Osterwalder and

Pigneur 2010). Its wide adoption and its description by nine components, compared to further conceptualizations often using four components (Foss and Saebi 2017; Gassmann et al. 2013; Teece 2010), offers enough complexity for our research endeavor while remaining relatively easy to comprehend.

Changing components of BMs affects an organizations' knowledge base (Delft et al. 2019) and the integration of this knowledge is important within BM design and innovation (Corbo et al. 2020; Delft et al. 2019; DiBella 2020) as well as for evolutionary adjustments (McDonald and Eisenhardt 2019). BM change should be actively engaged by organizations (Chesbrough 2010; Linder and Cantrell 2000; Teece 2018). The process of changes in and between components of a BM is understood as BM evolution (Demil and Lecocq 2010). The evolutionary aspects of BMs have been partly studied (Zott et al. 2011) on industry level (Banda et al. 2018; Bohnsack et al. 2014; Vaccaro and Cohn 2004). On organizational level, Antero et al. (2013) explain the need for an evolutionary perspective. Demil and Lecocq (2010) show that an organization's sustainability depends on anticipation of and reaction to voluntary and emerging changes between BM components. Davies and Doherty (2019) elaborate on the challenges of integrating hybrid objectives into value capture. While prior research provides insights into different aspects of BM evolution, what mechanisms constitute this process is not sufficiently understood. We also use the organizational level, adding a perspective toward platformization to show mechanisms of BM evolution towards multi-sided platforms based on opening value-creating processes and leveraging external knowledge sources.

Platform Business Models

The literature lacks a general definition of platform BMs (Fehrer et al. 2018) but agrees an open architecture, interoperability across technologies and the ability to connect various actors and their resources are central to facilitate the creation of value between actors (Coombes and Nicholson 2013; Fehrer et al. 2018; Kortmann and Piller 2016; Velu and Jacob 2016). Platform BMs are usually conceptualized as multi-sided markets, mediating supply and demand (de Reuver et al. 2018b). This characterization is based on the notion of platforms enabling different groups to interact via the platform (Gawer 2014; Schreieck et al. 2016), creating and deriving super-additive value (Clemons 2019). Thus, the platform owner's role is to develop and grow an ecosystem of different actors around a stable and reliable platform core (Staykova 2018). This core often provides a key functionality, which is consumed by users and extended through products and services provided by autonomous complementors (Hein et al. 2019a; Tiwana 2014). Hence, the modes for value creation in multi-sided platform BMs differ from those of linear value chain businesses (Dell'Era et al. 2020). For example, independent developers in Apple's App Store extend the basic value proposition of iOS towards users with their applications (Eaton et al. 2015). That way, multi-sided platform BMs allow organizations to grow rapidly and address an almost unlimited number of different customer problems. Hence, incumbents face the decision to change their BM from traditional, linear models towards platform-based ones (Dell'Era et al. 2020; Hein et al. 2019b).

However, for a multi-sided platform BM to be successful, getting users and complementors to participate is fundamental (McIntyre and Srinivasan 2017). Their diffusion relies strongly on network effects, which can be slowed down by various inhibiting factors (Wallbach et al. 2019). Extant literature has examined the emergence of digital platforms through the lens of launch strategies (e.g., Schirrmacher et al. 2017), technological trajectories (e.g., Hein et al. 2019b), or ecosystem structures underlying value co-creation (e.g., Basole and Karla 2012, Tiwana 2014). Their evolution has been studied from incumbents' perspective, either by evolving traditional product firms as a whole to platforms (Zhu and Furr 2016) or by intrapreneurially creating new platform firms (Abdelkafi et al. 2019; Brusoni and Prencipe 2009). The case of the International Data Spaces showcases how a multi-sided platform comes into existence from scratch within an alliance (Otto and Jarke 2019). Taking the BM as a central lens, further research builds a taxonomy of platform-based marketplaces as BMs (Täuscher and Laudien 2018), and provides a framework to understand platform BMs from a systemic perspective (Fehrer et al. 2018). While these perspectives allow selective insights into different aspects of platform emergence and specifics of multi-sided platform BMs, there is no comprehensive account of how multi-sided platforms come into existence and of the evolution of the underlying BM (Otto and Jarke 2019).

3 Research Design

We follow a single case study design (Yin 2014), suitable to approach 'how', as opposed to 'how much', questions (Sach 2015). Case studies provide valuable insights into real-life phenomena (Yin 2018) and theories emerging from them tend to be novel, testable, and empirically valid (Eisenhardt 1989). We employ a single, in-depth, exploratory, longitudinal, and inductive case study design. In exploratory studies, the aim is to find out what is happening in a particular context, generate insights, and propose hypotheses for future studies (Runeson et al. 2012). Multi-sided digital platforms represent a high complexity. As such, we looked for a BM originally based on software, as this provides a suitable ground to study the evolution, but does not incorporate further developments influencing our results, such as servitization of physical products (Steininger 2019). We sampled an organization from the software industry.

Concerning **case selection**, we chose *ServiceNow*, an IT enterprise headquartered in Santa Clara, California, and founded in 2004. The company generated a revenue of $3.46 Billion in 2019 and had approximately 10,000 full-time employees around the world. Starting with IT-service management, the company nowadays offers an enterprise suite for service management. It follows a single platform strategy with the *Now Platform* as its main product (Illsley 2018; Odell and Ferrif 2019; ServiceNow 2020b). Nowadays, it serves various global organizations (Gupta 2017), counting roughly 80% of Fortune500 companies as customers (ServiceNow 2020b). Furthermore, ServiceNow significantly changed its BM (Illsley 2018) from directly selling applications to transforming it into a multi-sided digital platform in a period of 16 years (Kenneth Gonzalez 2019). It "is the fastest-growing enterprise cloud software company in the world" (Kenneth Gonzalez 2019) underpinning the successful BM evolution to provide value to the case company. The uniqueness of the evolution of the case of ServiceNow requires the use of the single case study method.

Table 1 depicts our **data sources**. We used annual reports, shareholder documents, and further publicly available data such as analyst reports and news articles. The data provides different perspectives on the evolution of ServiceNow, i.e. from the organization's perspective as well as from shareholders, partners, customers, and the market. We focus on publicly available data to support the longitudinal study design, as a-posterior data gathering, especially interviews, tends to be biased, and considering the analysis period of 16 years, human memories tend to be clouded.

Type of Data Source	**Yearly coverage**	**Number of publications (and total of pages)**
Official annual reports	2012-2019	7 (1.203 pages)
Official investor relation reports	2012-2020	55 (696 pages)
Official product information documents	2006-2020	45 (350 pages)
Official company presentations	2013-2020	24 (1.034 pages)
Official customer service documents	2012-2020	8 (108 pages)
General publications	2013-2015	2 (20 pages)
HR documents	2015	3 (6 pages)
Partnership documents	2008-2019	19 (149 pages)
External reports (e.g. IDC, Gartner, Accenture)	2010-2019	33 (797 pages)
Total	**2006-2020**	**196 (4.363 pages)**

Table 1. Data Sources

We **analyzed the data** with a qualitative content analysis (Mayring 2015). We first created a narrative of the evolution of the organization (Pentland 1999). We then looked for specific events. We considered all occurrences having a strong impact on the development of ServiceNow's BM, i.e. impacting more than one BM component and triggering following events, as key events. Then, we deductively coded the identified key events into the nine elements of the BMC. We then aggregated these into a BM for each year of the analysis. Two researchers performed the coding independently. Cases that we disagreed on were discussed until an agreement was reached. To understand the evolution of the BM, we analyzed

the changes in the components of the BM chronologically for each year. We differentiated between primary BM changes, which are directly impacted by the relevant event, and secondary BM changes, which are a consequence based on the primary BM change. For example, in 2015 ServiceNow launched a store to provide customers access to content. We understand this key event as a primary change of the components channel and value proposition and at the same time the new activities and resources necessary to deliver this store as secondary changes. We subsequently used periodization, which is "[…] the process of dividing the chronological narrative into separately labeled sequential time periods with fairly distinct beginning and ending points" (Witkowski and Jones 2006) to derive three distinct episodes. These are based on the chronological overview of key events and subsequent BMs, resulting in a chronological illustration of changes on a timeline (Bohnsack et al. 2014), see Figure 1, as well as one aggregated BM per episode (summarized in Table 2).

To derive a **process model** we performed a cross-episode analysis (Antero et al. 2013). Specifying a process model lays out a set of mechanisms at work, which depict unfolding dynamics and explain events and outcomes (Cornelissen 2017; Langley 1999). We looked for within-episode and inter-episode similarities and differences (Eisenhardt 1989) as well as relationships between primary and secondary changes. Comparing insights from each episode, and also within the different BMs derived for each episode, we inductively identify consistent mechanisms and major changes. We looked for coherent configurations of the BM components between the episodes. Additionally, we looked for similarities or patterns in the changes, i.e. which components are affected, and if these are primary or secondary changes. With this approach of data analysis and synthesis, we identified different process steps of BM evolution, which, in the case of ServiceNow, lead to the overall evolution towards a multi-sided platform.

4 Findings

In the following, we first provide a narrative of key events in the BM evolution of ServiceNow. Subsequently, we introduce three distinct episodes through this process and elaborate on the respective BM changes. Lastly, we present a process model of BM evolution towards multi-sided platforms constituted of four distinctive mechanisms.

4.1 Key events of ServiceNow's evolution

In the 16 years of ServiceNow's company history, it developed from a small SaaS provider to a platform enterprise. The organization was founded as *Glidesoft, Inc*. in 2004. The original value proposition in our first analysis period was to deliver IT-solutions for IT departments, basically allowing to outsource IT operations to a managed cloud. For example, they offered a hosted service desk. This value proposition was extended in a second analysis period by developing a network of partners. ServiceNow started to enable partners to develop their applications based on the opening of their proprietary technological infrastructure towards them (single-side): The *Service Automation Platform*. Implementation partners helped customers to integrate the offerings into their system. In 2011, the founder stepped down as CEO and ServiceNow hired CEOs that have led large IT enterprises (e.g. Ebay, SAP). An IPO provided sufficient capital for further scaling. With the start of our third-analysis period with the introduction of an online enterprise application marketplace in 2015, ServiceNow aimed to "tap into partner ecosystem innovation" (ServiceNow 2016) and further opened the value creation logic towards a multi-sided platform. Complementing the introduction of an own store, SerivceNow started *CreateNow* as a third-party solution to build custom applications and a complementing developer program as well as an annual developer conference. In 2016, ServiceNow extended the strategic focus with the investment in "technology leadership" (ServiceNow 2017) and aquires various companies. In 2018, ServiceNow consolidated all offerings in one platform, the *Now Platform*, which enables partner and third-party application providers. Over this 16-year period, ServiceNow managed to continuously extend its network of partners and customers. Consequently, the company attained a significant market share as many global organizations rely on its offerings. ServiceNow extended its customer segments from IT departments of IT

enterprises to a diverse set of industries, including private, public, governmental, and educational organizations. This evolution is depicted in Figure 1 within three distinctive episodes.

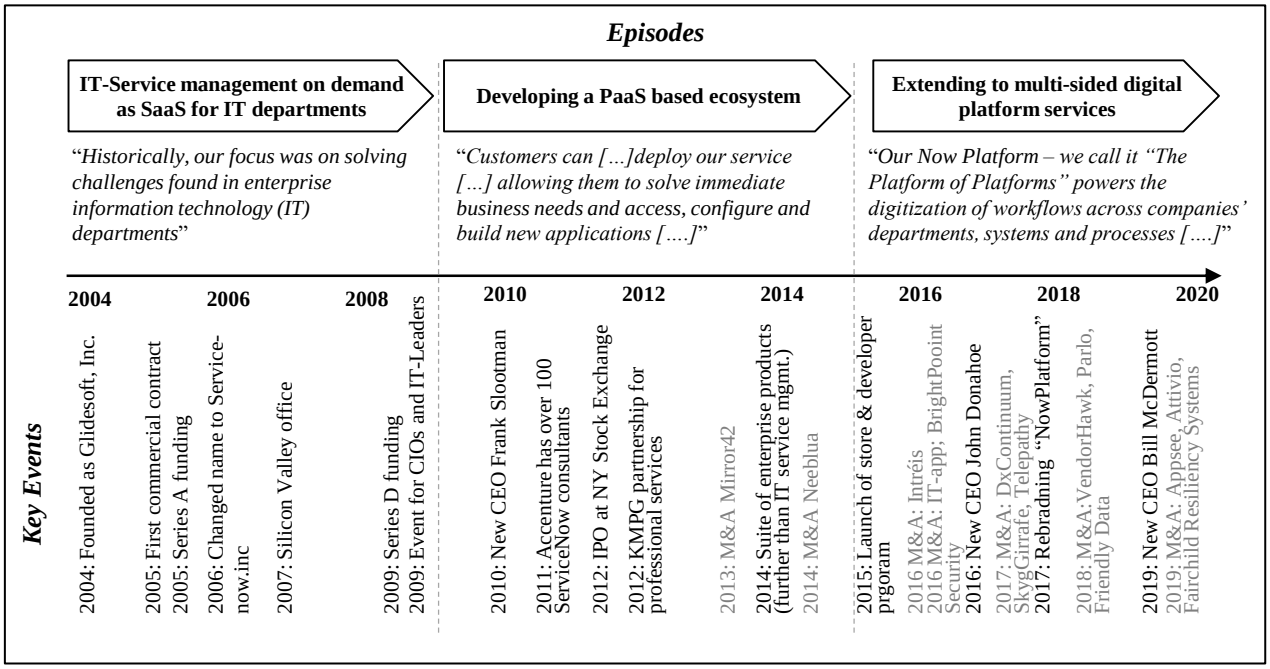

Figure 1. Episodes and Key Events of the Evolution of ServiceNow

4.2 Evolutionary episodes and corresponding business model changes

In the following, we detail the BM changes of the individual episodes. Figure 2 summarizes the evolution of the BM along the three episodes derived.

Episode Name	Key value proposition	Primary BM changes (in components of Business Model Canvas)	Secondary BM changes (in components of Business Model Canvas)	Key growth strategy
IT-Service Management on Demand (2004-2009)	Cloud-based delivery of IT solutions for IT-departments (SaaS)	• Shifting *value proposition* to entire service suites • Adding new *customer segments* like education	• *Activities*: Changing the name and engaging in founding rounds • *Resources*: Start of strong growth by hiring employees and invest in technologies • *Key partners*: starting initial consulting and integration partnerships	• Address new customer segments • Extend service offering
Developing a PaaS based Ecosystem (2009-2015)	Deliver custom applications to automate enterprise (IT) operations (SaaS) Enable customers to develop their own applications (PaaS & IaaS)	• Extending *value proposition* to offer partner ecosystem and PaaS, opening infrastructure to customers do develop their own applications • Targeting new c*ustomer segments* outside of IT departments to all organizational departments and new domains like governments • Retaining strong *customer relationships*, but with partners engaging in consultation and implementation • *Key partners*: Build strategic partnerships with large corporations like Accenture or IBM	• *Activities*: IPO, opening one side, starting 6-month update cycle, start of M&A, educating customers and partners • *Resources*: further investing in technologies, hire workforce and new CEO • Using partner's c*hannels* as additional sales opportunity; consulting and implementation partners to conduct projects	• Address new customer segments (outside of IT services) • Build and extend partnerships • Proprietary, single-sided platform strategy

Extending to Multi-sided Digital Platform Services (since 2015)	Ecosystem orchestration and enablement of partners and third parties to create value (Multi-sided platform)	• Extend *value proposition* to offer employee, customer, and administrative (finance, audit, security, IT, facilities, etc.) workflows for organizations from all domains • Strong *relationships* with *key customers*, yet often handled by responsible partners (ServiceNow becomes the solution provider, but face to customer often are partners) • Further engaging in strategic *partnerships* with large corporations like Microsoft, KMPG and extending partner base to over 1.200 • *Channels*: Introducing store and consolidating all offerings into one single platform; offering solutions via third parties like SAP store	• Engage in various M&A *activities* to extend technology base and follow a strategy of technology leadership; start of developer conferences and extensive training of partners and third parties • Extend technological *resources* and know-how by M&A offering boundary resources • Follow existing revenue-sharing logic, extending *revenue streams* with various partnership programs and opening new streams based on new channels (e.g. SAP store)	•M&As •Network effects •Developing & enabling partners •Multi-sided platform strategy

Table 2. BM Evolution of ServiceNow

IT-Service Management on Demand (2004 – 2009)

In the first episode, ServiceNow employees a SaaS BM, offering IT solutions to IT departments. ServiceNow develops its own proprietary software and offers it to first customers. Value creation relies on direct marketing of their solutions to potential customers. Financial resources are created from the first revenues, but also by funding rounds. Within that episode, the value proposition is extended to services, instead of just software solutions, for example in 2008 with *IT Service Management on Demand.* Additionally, new *customer segments* are addressed. Originally, ServiceNow offered their services to IT-departments of IT organizations, such as a Helpdesk. In 2008, for example, an on-demand agreement with the Ohio State University Medical Center is agreed, moving the organization from a traditional enterprise IT service desk to customer IT service management (e.g. incident management). In 2009, ServiceNow hosts an event for CIO's and IT leaders, actively building and scaling a network of strategic *key partners* and building the foundation for opening its' value creation.

Overall, the BM evolved as the *value proposition* shifted from specific software solutions to entire service suites in this episode. In parallel, new *customer segments* were addressed iteratively throughout the episode. Secondary changes occurred in the BM components of *key activities*, *key resources*, and *key partners*. The company extended its *customer segments* and its know-how.

Developing a PaaS based Ecosystem (2009 – 2015)

In the second episode, ServiceNow pushes the development and growth of an ecosystem of partners and adds PaaS to their SaaS BM. In 2012, the *value proposition* is communicated as a cloud service provider to automate enterprise IT operations. ServiceNow addresses new *customer segments* and extends its *value proposition* by not only providing it to IT departments but addressing enterprise departments, as they "[…] expanded from an IT constituency to an enterprise wide constituency. "[…] Now we're applying what we've learned to be able to address the needs of other parts of the enterprise", the vice president of product strategy states in 2014 (Tsidulko 2014). During that episode, the company introduces a fixed 6-month update cycle of its core product, which it still embraces today. The updates are used as the baseline rhythm to extend and adjust the overall *value proposition* and addressing new *customer segment*s. Within the second episode, ServiceNow aggregates and opens its technological infrastructure, the *Service Automation Platform*, towards its customers and *key partners*. ServiceNow still offers most services, covering IT, HR, and facility services, but enables partners and customers to develop their own custom applications. A 2013 published book by ServiceNow showcases how they start selling into new vertical industries. The 31 presented customer built-application stem from various industries: Coca-Cola (Consumer Goods), CERN (Research), NBA (sports association), Brit Insurance (Insurance), Bournemouth University (Education), Pacific Aluminum (Metals & Mining), Qualcomm (Communications), and Lemmikäinen (Construction) (ServiceNow 2013b). ServiceNow focuses on extending this strategy, planning in 2012 "to grow investments in our platform to better enable the creation

of custom applications to address specific business issues" (ServiceNow 2013a), financed by their IPO. The BM relies on consulting and implementation partners, e.g. KMPG or Accenture, partnering in 2012 for professional service offerings (accountingtoday.com 2012). ServiceNow offers consulting and training to partners and third parties, which in turn enable their customers. Regular product advisory meetings with partners allow co-evolution and integration of external know-how. The partners possess vertical know-how, specific to certain domains or processes. Enabling the partners thus not only increases sales capacities but extends the knowledge-base, as well as potential customers, as strong partners (e.g. established management consultancies) bring in their own customers. Still, ServiceNow is mainly responsible for the sales, while partners consult and implement.

In comparison to the first episode, the focus shifted from specific services to PaaS on top of Saas and the enablement of customers to develop custom applications. Various partnerships were formed and developed in consulting and implementation. As such, partnerships become crucial to the BM. The BM evolution in this episode required additional *financial resources*, opened the value creation logic and addressed new *customer segments*. ServiceNow followed the strategy to deliver everything as a service: SaaS for end-users, PaaS for developers, and IaaS for operations (ServiceNow 2015a).

Extending to Multi-sided Digital Platform Services (since 2015)

In the third episode, ServiceNow's BM evolves towards a multi-sided platform. The trigger is the introduction of an enterprise application marketplace in 2015, the *NowStore*, opening the value creation process. Additionally, the introduction of *CreateNow* addresses and enables third parties to build applications, which can be offered via the store. To educate and manage the developer community, a complementing developer program as well as an annual developer conference is introduced. The role of partners within the BM increases further, which now engage in sales activities themselves, compared to consultancy and implementation in the prior episode. With the store, existing partners, as well as third parties, gain access to potential new customers, outside their existing immediate customer portfolio. A "technology partner program" (ServiceNow 2020d) enables the partners to distribute their solutions in the store. As such, the BMs of the partners are actively enhanced, and ServiceNow's value creation logic moves towards enablement and orchestration. Still, until today, it offers various applications itself but does merely engage in sales and implementation activities. The actual value is produced with and by partners and third parties. New *customer segments* are addressed iteratively, often with the help of strong partners. For example, a partnership with Microsoft Azure directly addresses governments. To enhance technology and knowledge base, various acquisitions occur within that time. Applications for mobile devices are introduced, and security, artificial intelligence, especially machine learning, as well as data visualization and analytics, are central towards ServiceNow's mission towards "technology leadership" (ServiceNow 2017), allowing for example to predict the needs of employees. During that episode, for the first time an integration partner, *Intréis*, is acquired and integrated, which was providing risk and compliance services developed on the ServiceNow platform. In 2019 ServiceNow extends its *channels* by offering mobile applications and an HR Service app via the SAP App Center. Within the 2020 Covid-19 pandemic, they capitalize their learnings, quickly offering designated solutions to tackle the change in everyday life, for example with the *Safe Workplace Suite*, aimed to safely return employees to their workplace. Further in the episode, ServiceNow aggregates its offerings into one single infrastructure, the *Now Platform*. Further building and developing of partnerships lead to the opening of the value creation logic, with an ecosystem allowing to create the various value propositions. The current CEO Bill McDermott underpins the opening: "our *Now Platform* - we call it 'The Platform of Platforms'- powers the digitization of workflows across companies' departments, systems and processes by enabling existing systems and processes to work better together" (ServiceNow 2020a).

At the end of the episode, ServiceNow commercialized the knowledge, ideas, and assets of its customers, third-party developers, and other contributors and employed a multi-sided platform BM. As of 2020, it has strategic technology partnerships with tech-giants like Adobe, AWS, Cisco, IBM, Microsoft, SAP, and Slack, with established management consultancies and auditing specialists like KMPG, EY, Deloitte, and Accenture, and lists 1.248 partners on their portal (11/2020) (ServiceNow 2020c). By now consolidation of the partner ecosystem occurs, with Infosys and Accenture having acquired ServiceNow

partners itself, and Accenture even started a dedicated business group together with ServiceNow in October 2020. Although the *Now Platform* still contains numerous applications that were developed by the company itself, a large part of the *value proposition* today originates from the platform environment. The multi-sided platform leverages the combination of core functionalities provided by ServiceNow and third-party developed applications that use and build onto these core functionalities.

The episodes unveil that ServiceNow's transformation from a SaaS provider to a platform enterprise was moderated by a continuous extension of its *value proposition* to enable ecosystem development, as well as the acquisition of externally developed technologies. To do so, the *customer segments* were iteratively extended, targeting new segments once a time to support growth. Additionally, external know-how was further integrated into the value creation process. Further changes in components were necessary, and happened iteratively, not tipping the overall balance of the components to strongly.

4.3 Mechanisms for business model evolution towards multi-sided platforms

Our results show how BMs can evolve from niche-focus to a multi-sided platform BM. A cross-episode analysis compares insights from each episode, and also within the different BMs derived for each episode, to identify consistent mechanisms and major changes. The derived process model (Figure 3) shows how a BM evolves from closed to open the value creation, in our case based on developing and opening a proprietary platform to one side, and subsequently further opening the BM to multiple sides.

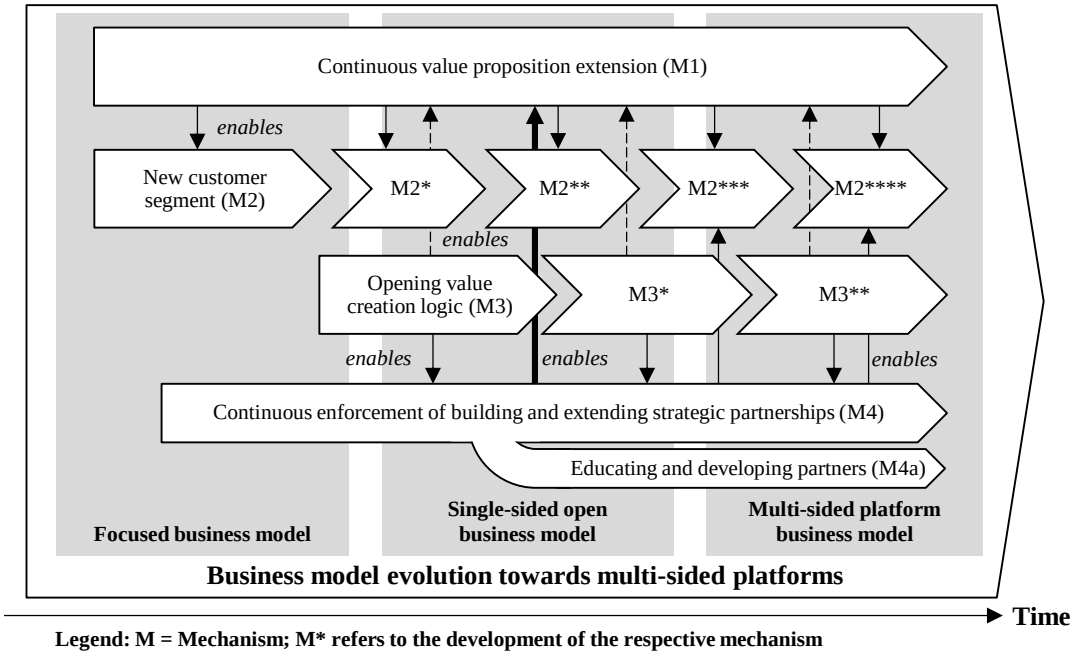

Figure 2. Model of business model evolution towards multi-sided platforms

Throughout all episodes, we identified the mechanism coined **continuous value proposition extension,** which was a primary BM change through all 16 years. To enable this extension, new products and services are constantly offering new value proposition, based on an extending organization's technology base. ServiceNow offers large releases with new functionalities and services in a 6-month cycle. From single applications with a narrow focus, first services are first created by the operator. Later customers are enabled to create their own solutions. Lastly, existing customers, partners but also third parties are enabled to offer their applications, creating additional value propositions. Central is the enforcement of synergies with existing and additional value propositions. The outcome of this mechanism is the enablement of scaling a BM, for example by allowing to address new customer segments.

The second mechanism describes the **iterative addressing of new customer segments**. New customer segments are addressed selectively. On the one hand, existing value propositions are marketed to new customer segments. On the other hand, new value propositions are created to enable the opening of

entirely new segments, often with the help of partners. Importantly, new customer segments are addressed one at a time, allowing experimentation and a continuous learning process, which in turn allows entering new segments subsequently, as stated by the VP of product strategy: "[…] we're applying what we've learned" (Tsidulko 2014). a first scanning process of potential growth segments is performed, the data interpreted, and the opportunity seized by addressing a new segment, and in turn, the learnings transferred to foster the opening of further segments, while the existing ones are scaled and addressed operatively.

We identified the third mechanism of **iterative opening the value creation logic**. The value creation shifts from the BM operator towards partners and consequently towards third parties. The basic logic of value creation moves from building and marketing a product or service towards integration of partners into the value creation and the enablement of partners (see mechanism 4). For example partners are educated in sales activities, which provide the actual value to end-customers. The value creation logic is further opened towards additional partners, and consequently, towards third parties. The value creation increasingly relies on the provision of core functionalities used by partners and third parties, opening a platform from a technical perspective. Outcome of this mechanism is the extension of value proposition and the enablement to build and extend partnerships, allowing to leverage external ideas and know-how and incurring lower costs.

The fourth mechanism refers to the **continuous enforcement of building and extending strategic partnerships.** To evolve a focused BM towards a multi-sided platform, a fruitful network of partners is necessary. Initial implementation partners are developed towards enablement partners, fostering co-evolution, and continuous learning, for example by moving from a pure implementation partner to additionally engage directly in sales activities. Additionally, customers can be developed to offer their own solutions via a store, opening a platform from an organizational perspective. As such, ServiceNow engages in the management of value creation of its partners, extending their knowledge base and allowing them to scale their BM. In the case of ServiceNow, with the release of a store in 2015, already over 80 "[…] value-added business applications created by technology partners, solution providers, systems integrators and service providers" as well as by ServiceNow were available to customers (ServiceNow 2015b). The development of the heterogeneous partners into new roles happens asynchronously. A specific behavior observed is the increase of ownership first, in the relation towards the partners, second in the partners themselves. Enforcing the mechanisms of extending value creation and a continuous learning process, in the case of ServiceNow, partners are directly acquired and integrated into the organization to extend the technology and knowledge base. The partners have their own customers and possess know-how in vertical domains, as such enabling to address new customer segments. In turn, the value proposition is extended by the partners' offerings.

Within Figure 2, the arrows show how the different mechanisms enable each other, for example, M1: Continuous value proposition extension enables M2: New Customer Segment. The thickness of the arrows within the figure is used to enhance readability and does not give any weighting of influence or importance.

5 Discussion

The results of the current study provide valuable insights into the evolution of BMs towards multi-sided platforms based on the case study of ServiceNow. From our data we find that ServiceNow traversed three phases from a close over a single-sided towards a multi-sided and open platform BM and utilized four different mechanisms. The findings have implications for research on BM evolution in general and BM evolution towards multi-sided platform BM in particular. Besides, using a BM lens, our study takes a new perspective on platform emergence and on the problem of platform launch strategies. Moreover, we provide insights on the opening process to engage selected partners in value co-creation first, before opening the platform to a broader range of partners.

First, our process model of BM evolution underlines the necessity of the BM lens (Massa et al. 2017) to develop new insights (Lanzolla and Markides 2020). We show the evolution of a BM based on continuous development and incremental changes, in line with Wirtz et al. (2016). Our case study shows how

an organization evolves its BM and achieves positive performance effects (see for example Foss and Saebi 2017). Compared to the proposition of Sosna et al. (2010) organizations do not necessarily have to rely on trial-and-error to innovate their BM. Rather, a controlled process of integrating and leveraging partners' know-how and resources within a learning process allows evolution without too much "error". Still, our findings enhance the proposition that successful BMs are rarely created out of the box (Chesbrough 2010; Christensen et al. 2016; Teece 2018), rather success is enabled by an evolutionary process and an adaptable BM. Further, the concept of BMs focuses on value creation and capture on the demand and supply side (Massa et al. 2017). Our mechanisms show the boundaries between demand and supply blur over time, which has mostly been neglected in prior studies on BM evolution. In contradiction to Bohnsack et al. (2014), who found that the value proposition did not change significantly in their observed cases, the value proposition development of ServiceNow was the main driver of its BM evolution. This further underpins the need to consider an evolutionary process taking various forms of value creation (Antero et al. 2013; Demil and Lecocq 2010). The mechanisms show that during BM evolution value creation is opened to enable co-creation (Vargo and Lusch 2010). Subsequently, activities change as well, as the operator of a BM shifts the focus of learning towards partner enablement and leveraging of external knowledge sources. While the role of partners within the evolution of BMs has been previously discussed (Demil and Lecocq 2010), our results show that also a partner's value creation is directly affected.

Second, the evolution of BMs towards multi-sided platform BMs represents an iterative process in which the focal firm strategically addresses platform sides sequentially or at the same time (Schirrmacher et al. 2017). Prior work has proposed different platform launch strategies, which aim to increase the attractiveness of the platform's value proposition to different user groups (Stummer et al. 2018). However, these launch strategies lack practical applicability (de Reuver et al. 2018a; Engert et al. 2019), and platform owners are challenged with detailing these strategies without further guidance. The mechanisms identified in the current paper provide much-needed insights and details on the various activities necessary to establish a digital platform ecosystem based on a sequential entry strategy. The case of ServiceNow shows that platforms emerge over several years while traversing three evolutionary episodes. That is, during the first episode, ServiceNow applied a traditional BM, which allowed it to attract users by offering a targeted value proposition to IT departments. Having established a sizable user base, ServiceNow broadened its value proposition to the user base by enabling existing users to integrate the platform deeper into their existing IT systems by allowing them to customize parts of the platform increasing its specialization. Finally, once the value proposition for users was in place, by opening up their business to partners, ServiceNow leveraged third parties to increase the scale and reach of the platform. The identified mechanisms underlying the three phases show how the different stakeholders (i.e., customers and partners) are addressed before establishing a platform, allowing insights into the strategic dimension of platform emergence (Staykova 2018). Purposefully leveraging these mechanisms, ServiceNow managed to overcome the multitude of inhibiting factors associated with the diffusion of platforms such as establishing the community and governing partners (Wallbach et al. 2019).

Third, we witness throughout the evolution of ServiceNow's BM towards a multi-sided platform how value creation shifts from the BM operator towards partners and consequently towards third parties, while the operator increasingly focuses on ecosystem orchestration and enablement. As such, BMs become more open during evolution towards multi-sided platform BMs (Fehrer et al. 2018). Growth moves from the single firm towards a platform ecosystem (Fu et al. 2017), requiring new activities of an operator to successfully scale the BM. We show the importance of strategic partnerships, as such a form of value co-creation, to realize exponential growth with a non-exponential increase of investments. For ServiceNow, it would have required substantial additional financial resources to generate necessary know-how and hire additional employees to achieve the same growth rates. Organizational ambidexterity plays a crucial role: Leveraging existing resources, the BM operator still develops and markets its offerings, yet continuously shifts value creation towards ecosystem orchestration and enablement of partners and third parties (de Reuver et al. 2018b). As proposed by Alt (2020), our results underpin the necessity to design the BM of participating market sides in digital platforms but show that this can be enabled by partnerships and is not required solely by a platform owner.

6 Conclusion

To survive in a demanding competitive environment, companies adapt their BM (Foss and Saebi 2017; Massa et al. 2017). Existing literature studies the evolution of BMs from an organizational perspective. Yet, how a BM evolves from closed to open and further to a multi-sided platform BM is mostly unknown. At the same time, platform emergence lacks a detailed view on the level of BMs. We perform a single in-depth case study of the IT company *ServiceNow* to provide insights on how organizations transition their BM to multi-sided platforms. To do so, continuously extending the value proposition, while iteratively adapting further BM components can be a successful approach. Constant extension of the service portfolio enables addressing new customer segments and providing new offerings to existing ones. In turn, created learnings extend the scope of innovation and allows capturing economies of scale. In the case of ServiceNow, the extension of technological know-how was further accelerated by inorganic growth. Strategic acquisitions can be a valuable extension to know-how and existing services if integration occurs fast to profit from synergies. We identify the four mechanisms of *continuous value proposition extension, iterative addressing of new customer segments, iterative opening the value creation logic,* and *continuous enforcement of building and extending strategic partnerships*, showing how BMs evolve towards multi-sided platforms. In the case described, ServiceNow starts as a specialized IT-service provider and, at the end of the analysis period from 2004-2020, is an agile platform organization.

Our research contributes to the literature on BM evolution and platform emergence. First, we provide a process model on BM evolution. Our in-depth case study showcases how organizations can successfully master the ambidexterity challenge of a BM still contributing revenues and profits, but adapting it to ensure future effectiveness (Sosna et al. 2010). Further, the derived mechanisms show how paths of evolutionary dynamics occur and can be fostered within BM evolution. Second, we contextualize BM evolution to the context of digital platform ecosystems. Previous research has studied platform evolution, either by looking at how traditional product firms as a whole evolve to platforms (Zhu and Furr 2016) or how new platform firms are created intrapreneurly (Brusoni and Prencipe 2009). We provide a novel perspective, showing a service firm evolving its' BM towards a multi-sided platform, as such offering a contextualization of BM evolution for platform ecosystems. Further, the results show how organic and adjacent growth of organizations can lead to the evolution of BM towards multi-sided platforms. Third, we bridge literature on BM evolution and platform evolution. The study provides empirical evidence on the successful operationalization of a platform launch strategy by a platform owner through purposefully changing its BM to attract users and complementors. That way, we answer calls to advance research on digital platform ecosystems concerning the implementation of launch strategies and the related BM changes (de Reuver et al. 2018a). Further, our results support incumbents in the decision of changing their BM from traditional, linear models towards platform-based ones (Dell'Era et al. 2020; Hein et al. 2019b).

Single-case studies can produce valuable and detailed insights. Yet, with a single-case study research design, these insights are in their nature partly limited and cannot provide a general truth as they can only be generalized to a limited extend and lack further validation through e.g., cross-case analysis (Yin 2018). Part of our sources are official documents by the case company, which tend to be simplified and reduced in their complexity. Augmenting the current study with interview data yields important insights into the reasoning and complexity of the decision making processes associated with these often simplified statements. Additionally, the qualitative content analysis and coding performed is always partly subjective. Coding by two independent researchers mitigates this issue, but cannot fully resolve it. Consequently, the time intervals of the episodes identified only have limited validity, underpinning the nuanced nature of the iterative process of evolution. However, process phenomena, as is the evolution of a BM, have, in general, a fluid character spreading out over both space and time (Pettigrew 1992).

We see different avenues of future research, especially in the field of BM evolution. Future research might provide further mechanisms of BM evolution. An interesting point of consideration can be organizational learning theory and its role within BM evolution (Levitt and March 1988; Loon et al. 2020).

Similar, how strategic agility (Doz and Kosonen 2008) as well as organizational resilience (Vogus and Sutcliffe 2007) constitute towards BM evolution provides a fruitful avenue for future research. Another aspect is to consider the use of IT in BMs (Steininger 2019) and its different impacts onto BM evolution. Our approach of differentiating between primary and secondary BM changes and the resulting mechanisms can serve as an analytical framework. Longitudinal studies based on cases or periodic surveys can increase the validity to create robust practical guidelines to evolve BM towards multi-sided platforms. Furthermore, the context of enterprise software provides various avenues for future research for BM as well as platform literature alike.

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Appendix D. How Business Model Innovation fosters Organizational Resilience during COVID-19 (P4)

Aug 9th, 12:00 AM

How Business Model Innovation fosters Organizational Resilience during COVID-19

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How Business Model Innovation fosters Organizational Resilience during COVID-19

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Abstract

The COVID-19 pandemic imposes various challenges on societies as well as on organizations, especially in the medical sector. Organizational resilience is a central ability to strive through these challenges. Business model innovation can be a tool to build organizational resilience. Yet, it is unclear how business model innovation fosters organizational resilience. Therefore, we conduct a longitudinal case study on *Laboratory Inc.*, which adapts to the situation, innovates its business model to allow testing for the virus from home, and transmits results digitally. Our results show how organizational resilience is built by business model innovation. The business model innovations performed are not temporary, but lead to a new status of the organization, preparing it for future crises. At the same time, we demonstrate how digital innovations help to overcome crises and support socio-economic value. Our findings contribute to research on organizational resilience as well as on business models under external threats.

Keywords

Business Model Innovation, Organizational Resilience, Medical Laboratories, COVID-19, external shock

Introduction

The COVID-19 pandemic is affecting the worldwide economy and health system (Hemel and Rodriguez 2020). Temporary shutdowns of large parts of the global economy, the closing of national borders, as well as the need to stay at home affect almost all businesses. Testing for the virus has become critical in 2020. The rapid collection and analysis of appropriate samples is a priority for the clinical management and control of the pandemic and should be guided by laboratory experts. Large volumes of tests have to be performed as accurately and as quickly as possible and the results transmitted swiftly. Firms in general, and especially medical organizations such as laboratories, need organizational resilience to cope with challenges brought by this situation (Floetgen et al. 2021) .

The concept of resilience has proven useful with overcoming exogenous shocks, such as COVID-19 (e.g., Rapaccini et al. 2020; Sakurai and Chughtai 2020) or the 2008 financial crisis (DesJardine et al. 2019). Nowadays, organizations need to prepare for higher levels of volatility, uncertainty, complexity, and ambiguity (Suarez and Montes 2020); resilience can offer the capability to cope with these challenges (Buliga et al. 2016; Lengnick-Hall et al. 2011).

Through business model innovation (BMI), organizations adapt their business model (BM) to cope with external influences to ensure survival, creating a competitive advantage (Böttcher and Weking 2020; Foss and Saebi 2017; Wirtz et al. 2016). Firms use BMI to respond to external shocks, and as such, BMI can be a tool to build organizational resilience (Buliga et al. 2016). Yet, many firms fail to innovate their BM, and thus are unsuccessful with building organizational resilience.

In research, the connection between BMI and organizational resilience is understudied (Buliga et al. 2016). Furthermore, organizational resilience suggests an intermediary state assumed by organizations, for a limited period, to cope with certain circumstances. After changing from an initial to a temporary state,

organizations then return to the initial state (Sutcliffe and Vogus 2003). Initial research suggests that firms change and do not fall back into a state before experiencing a shock, but rather stay in a certain new state. For example, the 2008 financial crisis led to the launch of the platform economy (Boh et al. 2020), which proposed a new state for conducting business; however, this was primarily for new entrants instead of incumbents. There may be lasting change, with BMIs beeing here to stay and placing organizations into new states of resilience, enabling them to cope with new situations. Research has not reached theoretical convergence, and thus, we focus on the following research question: *How can firms leverage business model innovations to establish organizational resilience?*

We conduct a single longitudinal case study of *Laboratory Inc*. Analyzing the BM over two decades, we look at BMIs conducted, and the influence that the external trigger of COVID-19 has on the frequency of innovations. We then elaborate upon if and how organizational resilience is fostered by BMI. *Laboratory Inc.* adapted to the situation, digitized customer channels, started new collaborations with start-ups, and showed organizational resilience by adapting quickly and effectively to the COVID-19 situation. We study if and how BMIs conducted are temporary, and how they lead to a new state of organizational resilience.

Our study is grounded at the intersection of three research streams: organizational resilience, BMIs, and the impact of crises on BMs. Bridging literature on organizational resilience and BMIs, we showcase how BMI fosters the development of organizational resilience and how COVID-19 induced BMIs lead to a new normal of organizational resilience, enabling to cope with future shocks. We further contribute to the literature on BMs, showing how BMIs are accelerated by external events. Lastly, we show how digital innovations create socio-economic value across organizational boundaries.

Organizational Resilience through Business Model Innovation

Organizational Resilience

Resilience has been an emerging focus in different disciplines, such as ecology, psychology, engineering, management, and information systems (Müller et al. 2013). Resilience is the ability to resist and respond to a shock and to recover after a shock has occurred (Annarelli and Nonino 2016; Rose 2004). Taking an organizational perspective, organizational resilience refers to a firm's ability to operate, and even thrive, through an impairment by adapting quickly and effectively to the situation. Indeed, resilient organizations are successful in coping with crises (Suarez and Montes 2020). The concept of resilience is investigated in the context of exogenous shocks, including recent COVID-19 studies (e.g., Sakurai and Chughtai 2020).

Organizational resilience is a complex construct, which, by definition, is characterized by different elements or attributes. There are various studies on resilience (Annarelli and Nonino 2016; Bhamra et al. 2011; Rose 2004) and differentiation of its dimensions supports casting light on this complex construct. The dimensions can be roughly differentiated as *resources that enable the development and maintenance of competencies,* and *motivation systems and processes that promote effectiveness and growth* (Sutcliffe and Vogus 2003). More detailed, the standard ISO 22316 (ISO 2017) describes nine different attributes of organizational resilience. These attributes are reflected in prior related literature (Avery and Bergsteiner 2011; Di Bella 2014; Sutcliffe and Vogus 2003; Weick et al. 1999). We also use the nine factors to grasp organizational resilience and differentiate them between the two dimensions introduced.

Dimensions	**Attributes of organizational resilience**
Resources to develop and maintain competencies	Understanding internal and external context
	Anticipating change and managing necessary adjustments
	Availability of resources to enable adaptation
	Evaluate results and identify opportunities
	Mutual learning
Motivation systems and processes of effectiveness and growth	Coordination of business units to strategic goals
	Shared vision, goals, and values, and purpose of the organization
	Effective and encouraging leadership
	Positive cult

Table 1. Dimensions and attributes of organizational resilience

When responding to external threats, firms can be backward or forward-oriented. Backward-oriented refers to "bouncing back" to a previously existing "shape" (Sutcliffe and Vogus 2003) and going back to normal

operations of essential structures and functions (Rice and Caniato 2003). Forward-oriented actions, meanwhile, bring renewal beyond mere "adaptation" (Hamel and Välikangas 2003). Forward-oriented actions refer to a proactive way of dynamically responding to situations. Examples are transforming (Walker and Salt 2012), developing a new identity (Wastell et al. 2007), or capturing new opportunities (Hamel and Välikangas 2003). This stands in contrast to returning to an original state, which was unable to cope with the immediate shock in the first place (Sakurai and Chughtai 2020).

Business Model Innovation

Firms can respond to external shocks through BMI, based on a set of pre-conditions. They change their BM to cope with changing circumstances and to allow new ways of value creation, capture, and delivery (Foss and Saebi 2017; Wirtz et al. 2016). In general, BMs can be understood as a dynamically changing activity system, constituted by interdependent activities of a firm and its partners to create value (Arbussa et al. 2017; Zott and Amit 2010). BMs can be aggregated into four distinctive constituting components: *value proposition, market segments, value chain,* and *value capture mechanisms* (Foss and Saebi 2017; Weking et al. 2020), which we will use to cluster the BM of *Laboratory Inc*.

BMI plays a role in organizational resilience, as organizational responses lead to changes in the BM. Resilience is even considered a means to cope with a situation and improve the BM (Casalino et al. 2019). The research stream regarding the impact of crises on BMs looked at this phenomenon, analyzing the role of BMs in the dot-com crash (Magretta 2002; Porter 2001), of financial crises (Altunbas et al. 2011; Hryckiewicz and Kozłowski 2017), and natural disasters (Ritchie 2004; Tsai and Chen 2011).

More recently, publications concerning the impact of COVID-19 appear (Erdelen and Richardson 2021; Gregurec et al. 2021; Seetharaman 2020). Additionally, there have been further calls for papers to understand resilience, e.g., by using information technology (Boh et al. 2020; Sakurai and Chughtai 2020). Yet, forward-oriented resilience is understudied, and how BMI fosters resilience is not understood. We look at organizational resilience to understand if and how BMI fosters organizational resilience, and if it represents a forward orientation, enabling organizations to cope with future crises.

Methodology: Longitudinal Case Study

We use a longitudinal, single case study design to study the development of organizational resilience in *Laboratory Inc*. We study the case from a business perspective, using the BM as a conceptual framework, as well as from an organizational perspective. We use different elicitation methods to create different types of data as well as multiple data sources to allow data triangulation (Yin 2018). We used publicly available data sources, e.g., press releases and homepages of the case company and partners, as well as news articles mentioning the firm. Furthermore, we conducted interviews with employees from the company between January-October 2020. The Chief Digital Officer (CDO) served as a key informant, accompanying the research process. Additionally, we were allowed to engage in non-formal interviews as well as direct observations.

	Interview Partner	**Length Of Interview**
Interview 1	Head of pre-and post-analytic department	52 min
Interview 2	Laboratory Doctor	22 min
Interview 3	CDO	40 min
Interview 4		40 min
Interview 5		40 min
Interview 6		20 min

Table 2. Overview of interviews conducted

We use open, axial, and selective coding (Corbin and Strauss 1990; Glaser and Strauss 2008) to analyze the data. We analyze the data sources chronologically, coding all documents along the four BM components introduced (see Table 1), noting the time, and concurring events during that time. To create a timeline, we use periodization and structure the various BMIs along two episodes. Irregularities and ambiguities in the results are resolved by going back to data collection and analysis. For specific findings, interview partners were asked to validate precise information via email or calls.

Results

Laboratory Inc. during COVID-19

Laboratory diagnostic tests, also known as *in-vitro diagnostics* (IVD), are non-invasive tests performed on biological samples to diagnose diseases (Cortelyou-Ward et al. 2010). Medical laboratories analyze medical tests mainly for B2B customers, i.e., hospitals, clinics, and doctors. Their value creation is structured in three stages: a pre-analytical stage (material supply, shipping, order processing, preparation of samples), an analysis stage (sample analysis, physical storage of samples for five days, data processing, discarding of the medical specimen), and a post-analytical stage (authorization and reporting of results, invoicing). Laboratories are subject to various legal requirements, e, while processing personal data. Within the last decade, laboratory development was driven by workflow automation, product digitization to reduce laboratory costs, the introduction of point-of-care practices for speed test results, and personalized medicine for quality of life enhancement (Germany Trade & Invest 2018). Wider test spectrums and limited reimbursements obligate laboratories to become more efficient, and at the same time opportunites to optimize and add new revenue streams have to be identified. The incorporation of IT into workflows aims to reduce costs, eliminate manual processes, and boost automation (Plebani 2015).

IVD contributed to the diagnosing and care of patients with confirmed or suspected COVID-19, infections, and IVD takes a critical role during the COVID-19 pandemic (Lippi and Plebani 2020). Laboratories have developed strategies to cope with the pandemic, involving significant investments in laboratory resources, reinforcement of regional networks, installations of mobile laboratories, and the establishment of laboratory emergency plans (Lippi and Plebani 2020). This is also the case for *Laboratory Inc.* The company is four decades old and operates out of eleven permanent physical locations in Europe. With over 500 employees and an annual turnover of over 50 million €, *Laboratory Inc.* offers a wide range of services (e.g. clinical chemistry, hematology, immunology) covering pre-, post-, and the analysis stage itself. *Laboratory Inc.* partnered with a large European city to analyze COVID-19 tests; it quickly shifted to digital services, reconfiguring its value and developing digital channels to allow B2C result transmissions.

Business Model Innovation of Laboratory Inc. before and during COVID-19

Laboratory Inc.'s BMI follows some general drivers, which represent mid-and long-term occurrences of economic, political, and social phenomena. For *Laboratory Inc.* globalization, digitization, Internet-of-Things, growing demand for customization, and the technization of healthcare all drive innovation on a broader, long-term scale (Klein et al. 2017). Yet, the COVID-19 pandemic exposed the organization to more specific and immediate triggers, influencing BMI and requiring quick action. To control the pandemic, test results are required as quickly as possible, while simultaneously, physical contact must be minimized. This in turn means shorter testing times, as well as faster transmission of results to recipients. These are, compared to "regular" tests, new stakeholders, not only for doctors and hospitals but also for public health administrators and patients themselves. As such, new channels for the transmission of results are necessary. Lastly, the large-scale testing leads to spikes in demand, resulting in volume growth.

Laboratory Inc.'s Business Model Innovation pre COVID-19

Laboratory Inc. has performed different BMIs since the mid-2000s, affecting its *value proposition*. In the pre-analytical phase, the introduction of electronic orders allowed outsourcing patients' data registration, making it accessible at any time. This offered new value, as modifications of tests are enabled after initial ordering. Digital orders reduce processing time, errors, and manual labor associated with data integration.

Furthermore, *Laboratory Inc.* innovated its *value ch*ain. In the pre-analytical stage, it developed new service forms for sample analysis. Clinics and doctors use these forms to place orders and send in samples. In 2007, *Laboratory Inc.* adapted handwritten forms to be recognizable by Optical Character Recognition systems. This provides direct integration of the data into the laboratory information system and mitigates the human risk of processing information incorrectly. Data is now available fully digital; *Laboratory Inc.* provides software for online order entries to hospitals since 2010 and to private clinics since 2012, offering the transmission of both samples and findings. Before 2010, results were sent via courier service, post, or fax. In 2010, *Laboratory Inc.* started the digital transmission of results. If alarming values are encountered in an analysis, a fax can be directly sent to the doctor's clinic. Since 2015, customers can choose between fax and SMS for emergency reporting, allowing them to reach doctors outside of working hours. In 2018,

Laboratory Inc. implemented the so-called remote data transmission of results, in which patient data is encrypted, following GDPR, and sent to the practice systems. Since 2017, Laboratory Inc. offers on-premise serves for remote and online transmission of results, and cloud servers are available since 2018.

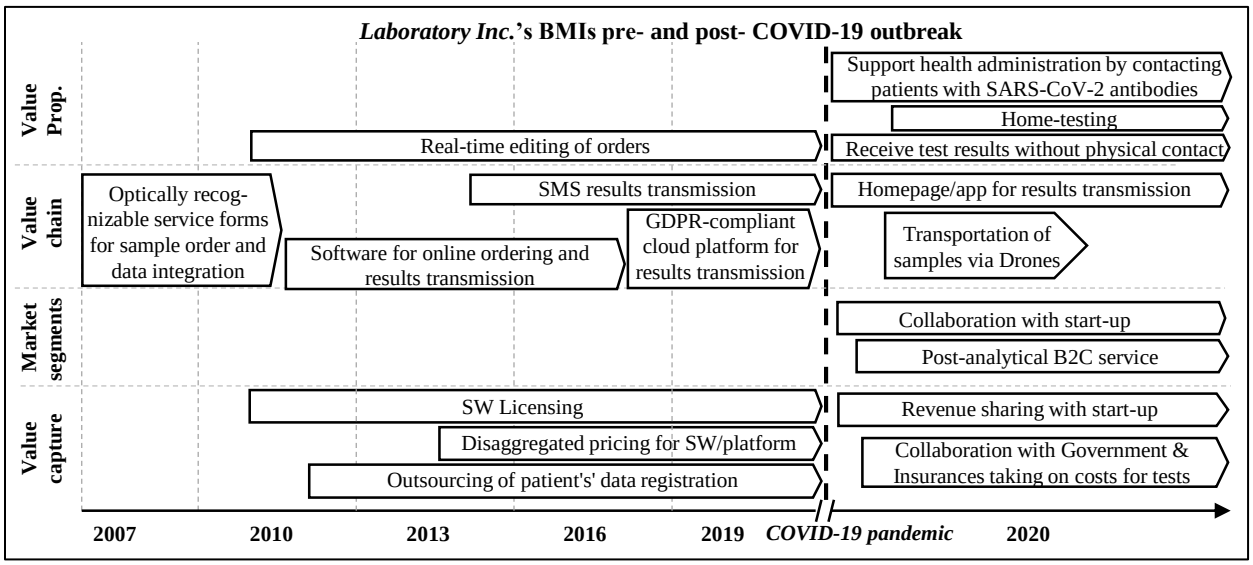

Figure 1. Business model innovation of Laboratory Inc. over two decades

Laboratory Inc. optimizes its *value capture* by digitizing sample orders, allowing it to maintain staff levels while increasing the number of customers. With the introduction of online result transmissions (on-premise as well as cloud), *Laboratory Inc.* uses disaggregated pricing and recurring revenue streams. Hospitals pay a fixed fee for the operation of the software and pay per test. Small clinics with a high number of regular orders receive the service for free. All remaining orders reflect one payment per order.

Laboratory Inc.'s Business Model Innovation since COVID-19

Laboratory Inc. has been largely influenced by the COVID-19 infectious disease. To address the health crisis, the laboratory has developed strategies that led to offering new services, aligning with new partners, implementing new channels, and defining relationships with new customers.

Laboratory Inc. performed BMIs to offer new *value propositions* to patients, and on a broader scale, to society in general. *Laboratory Inc.* developed a new service in which patients can order COVID-19 tests online, receive the material, test themselves, send the sample to the laboratory, and check the results through a website or an app, all without leaving home. For these patients, this delivers additional value, as results are not only available faster, but they don't have to expose themselves or others to risks of infection. *Laboratory Inc.* now offers B2C services in the post-analytical phase to all patients. Additionaly, it is possible to detect people with positive antibodies or contact appropriate patients directly, based on the online service, for donating plasma to support the health system in controlling the pandemic.

Adapting its *value chain, Laboratory Inc.* partnered with a start-up to further drive website and app development for the digital transmission of COVID-19 tests. The cooperation promotes point-of-care (home-testing) since many patients are afraid to leave their homes due to the viral infection. *Laboratory Inc.* provides the test material to patients' residences via mail. To further diminish physical contact and lower processing times of samples, in 2020 *Laboratory Inc.* tested drones to transport samples directly from hospitals to laboratories: "*The outcome was efficient; fast and direct*" (Interview 2). *Laboratory Inc.* added COVID-19 specific tests to their spectral analysis portfolio, leading to a huge spike in demand. To cope, medical and non-medical staff were recruited to aid in testing, analysis, and administration.

Since the start of the COVID-19 outbreak, the different BMIs also allowed addressing new *market segments*. Directly addressing private patients, without doctors or hospitals as intermediaries, created a B2C business segment. For the first time, in result transmissions and physical testing, B2C is directly enabled. Furthermore, the new services address telemedicine providers as well as medical advisors.

The reliability and speed to receive test results from the online service have led to an increase in the number of private patients, influencing *value capture*. Patients prefer to register with virtual clinics or medical advisors to reduce physical contact: "*An increase in customers translates into a greater financial possibility at the end of the day*" (Interview 2). The service co-developed with the start-up is free for end-users, i.e., patients and/or doctors, which is a BMI new to *Laboratory Inc*. Costs are forwarded to insurance providers or public health administration, which defray test costs. Revenues are shared with the new partner, creating a symbiotic partnership.

While *Laboratory Inc*. has performed various BMIs over the last two decades, BMI was triggered and accelerated by the COVID-19 pandemic. The BMIs performed have fostered organizational resilience. Disintermediation has occurred, and B2C business created and scaled. The laboratory has identified opportunities to address the global crisis. Patients can receive results directly, creating new opportunities for innovation and contributing to the creation of new value. "*This new electronic retransmission of results has the potential to give new meaning to the electronic form in medicine*" (Interview 4).

Business Model Innovation fostering Organizational Resilience

Through BMIs, *Laboratory Inc*. has fostered the development and maintenance of organizational resilience. *Laboratory Inc.* is able to operate through the impairment and gains new customer segments, and increase revenue. Table 3 summarizes how the various BMIs foster organizational resilience.

BMI/ Organizational Resilience Attribute		Development and maintenance of competencies	Motivation systems and processes that promote effectiveness and growth
Value proposition	Real-Time order editing	Competencies to digitally transmit patients' data securely	
	Contact antibody patients	Develop competencies and provide solutions to control the pandemic	Motivation to provide societal value
	Home-Testing	Competencies to tests without physical personnel presence and ship material	Process to increase the efficiency of testing Process to promote growth
	COVID-19 Online results transmission	Competencies to digitally transmit personal data safe and secure	
Value chain	Optically recognizable service forms		System to support growth
	SW for online order entry and results transmission	Competencies to digitally transmit personal data safe and secure as well as to implement and operate cloud-software	System to enhance quality and support growth
	SMS results transmission		Ensuring effectiveness in urgent situations
	Platform results transmission	Competencies to implement and operate platforms	
	Homepage/APP results transmission	Competencies to digitally transmit personal data safe and secure	
	Drone transport	Competencies to install new means of sample transport	
Market	Collaboration with start-ups	Competencies to quickly build and scale new solutions	
	Post-Analytical B2C Service	Competencies to provide end-consumer service	
Value capture	Outsourcing registration		Process to increase efficiency
	SW licensing	Competencies to implement new revenue models	
	Disaggregate pricing	Competencies to implement new revenue models	
	Revenue sharing	Competencies to implement new revenue models	Growth by collaboration
	Free for user testing		Motivation to provide social value Process to support growth
Legend	Pre-Covid-19 BMI	Post-Covid-19 BMI	

Table 3. Laboratory Inc.'s business model innovations fostering organizational resilience

Prior to COVID-19, *Laboratory Inc.* performed BMIs within their *value proposition* offered. Through real-time editing order entries, it built up competencies to digitally transmit patients' data securely. These

competencies allowed adapting services toward digital data transmission. Since COVID-19, the BMIs in the *value proposition* have allowed contacting antibody patients, as well as home-testing and online results transmission, which reduce infection risks. With these BMIs, the laboratory establishes competencies to tests without personnel presence, sending the material directly to consumers, and transmitting results digitally, enhancing the testing system and promoting growth. These new capabilities and systems allow *Laboratory Inc.* to quickly *re-align resources*, *anticipate change,* and *manage adjustments*, as well as to *coordinate the business toward a unified goal*, fostering organizational resilience.

In its *value chain*, *Laboratory Inc.* identifies opportunities to increase the systems' efficiency and effectiveness. SMS transmission of alarm values improves post-analytical system responses to emergencies. Digitization of channels, both for order entry and transmission of results, builds up resources to initially deploy and operate software (cloud and on-premise), with digital platforms following later. These competencies foster organizational resilience, as *Laboratory Inc.* can now better *understand the external context*, *anticipate changes*, and *quickly make resources available*. Furthermore, these BMIs drive data standardization. Combining with semantic annotation as well as analysis of large-scale data can now be leveraged as new BMIs within new situations, as new *opportunities* to use, combine, and interpret data arise (Abhyankar et al., 2012). The competencies to give data meaning helps to *identify opportunities and threats* (e.g., a new mutation of a virus), and enable a *mutual learning* process, further fostering organizational resilience. Newly developed competencies to offer COVID-19 specific digital channels now allow *reacting to future external events* and can be leveraged within all services of *Laboratory Inc.* By testing drones to increase transport efficiency, *fast adaptation* and *anticipation of change* are enabled for future events requiring rapid response, e.g., a shutdown or natural disaster restricting outdoor access.

New collaboration with start-ups during COVID-19 has allowed the *re-alignment of internal and external resources* and has enabled *mutual learning*. *Laboratory Inc.* implements a direct interface toward public health administration. While it is specifically installed to cope with the COVID-19 pandemic, it further increases organizational resilience as, in case of further external events, it can be leveraged to quickly make relevant data available for stakeholders, such as governmental entities. Additionally, it *motivates by creating a shared vision*, serving a greater, socio-economic purpose.

Laboratory Inc. optimizes its *value capture* by using revenue sharing and offering free for user tests. The new capabilities and partnerships in place to offer free testing again create *mutual learning*, and enable the firm to *react to future external events* by quickly offering and scaling similar, free for users, services.

Discussing Business Model Innovation's Role in a New Normal of Organizational Resilience

Laboratory Inc. performed various BMIs which foster the development of organizational resilience. The COVID-19 pandemic requires resilience in organizations and accelerates its development. The adaptation of digital channels was rather slow pre-COVID-19; however, by now, the majority of doctors demand digital data transmission and even ask for industry-wide data standardization. While these BMIs have been in place pre-COVID-19, *Laboratory Inc.* realized their potential through the outbreak and quickly scaled the BMIs for new users. In results transmission, various BMIs have been triggered by the COVID-19 pandemic. The implemented BMIs foster the development of different attributes of organizational agility. The BMIs put systems and capabilities in place to *understand the external context*, *anticipate change,* and *manage adjustments*, as well as the *capability to quickly re-align resources*, *mutual learning*, and the *coordination of strategic goals*, fostering organizational resilience. With external events triggering BMI, in turn, this shows how organizational resilience is fostered and its development is accelerated, which prepared *Laboratory Inc.* to proactively and quickly react to future exogenous shocks. As such, our results show how external events trigger the development of organizational resilience and accelerate it based on various BMIs.

While these BMIs are a clear reaction to this external shock, they are not temporary. Rather, they are the new normal of organizational resilience in *Laboratory Inc.*: "*Although this process will take longer than 5 years, the change has already started*" (Interview 2). This new status creates new opportunities, and, leads to a new normal, moving organization beyond previous equilibriums (Sutcliffe and Vogus 2003) and representing a forward orientation. In the case of *Laboratory Inc.*, the permanent BMIs also foster the permanent development of systems and capabilities of organizational resilience, which can be leveraged in

future situations. It shows how, under extreme circumstances, BMs not only react but can improve under stress to leverage their full potential, as was the case for *Laboratory Inc.* (Taleb 2013). These "antifragile" BMs (Ritter and Pedersen 2020) lead to irreversible changes. Compared to the common approach of building organizational resilience defensively and reactively (Annarelli and Nonino 2016; Sawik 2013), BMI can proactively foster organizational resilience.

Conclusion

The COVID-19 pandemic is a global challenge for individuals, organizations, and societies alike. To cope with crises, organizations require organizational resilience. We conducted a single longitudinal case study on *Laboratory Inc.* to analyze how BMI fosters organizational resilience. *Laboratory Inc.*'s BMIs have been accelerated by COVID-19, leading to the development of organizational resilience. By providing new services, like home-testing, the BMIs not only allow new value creation but also serve a greater, socio-economic purpose. The case demonstrates how, on the one hand, BMI leads toward a new, lasting state of organizational resilience, while simultaneously showing how digital innovations help to overcome crises.

We contribute to the literature on organizational resilience and show how BMI fosters the development of organizational resilience. While BMIs, in short term, serve a specific purpose, e.g.,. providing new value, not only are BMIs here to stay, but they lead to the development of systems and competencies to handle uncertain situations. Based on the BMIs, *Laboratory Inc.* created a foundation to react to new external shocks.

We further contribute to the literature on BMI and the impact of crises on BMs. We show how long-term drivers, such as technology advancement, and regulatory legislation are interrupted by immediate triggers, and how these triggers, in turn, lead to BMI. Looking at the sector of IVD, a rather traditional sector, we witness the fluidity of BMs, and how BMI is accelerated in complex and immediate situations of change, i.e., the COVID-19 pandemic. Furthermore, our results underpin how the COVID-19 pandemic might lead to a new normal of resilient organizations, similar to the 2008 financial crisis leading to the platform economy (Boh et al. 2020). On a broader scale, the case of *Laboratory Inc.* shows how digital innovations create benefits over organizational boundaries, i.e. how it leads to socio-economic developments to support health administrations and support governments in handling pandemics. New means of digital transmission and the foundation to perform data analytics can support overcoming the ongoing health crisis and mitigate possible future shocks.

This study has its limitations. This paper aims to analyze a longitudinal case over two decades. A single case study is partly constrained in its generalizability (Yin 2018), and coding performed in line with grounded theory is always partly subjective (Thomas and James 2006). Triangulation of heterogeneous data sources mitigates these issues. Furthermore, the interviews were in part retrospective, which we mitigated by additionally analyzing further available sources.

Future studies can elaborate on the mechanisms of how BMI utilizes organizational resilience, and if different types of BMI are more suitable to develop and maintain organizational resilience. Another interesting point of consideration would be to evaluate how organizations with different levels of resilience engage in BMI, and in turn to evaluate to what extent the enablement of BMI to develop organizational resilience depends on the existing resilience within an organization. Our study illustrates the BM in the diagnostics industry, focusing on efficient high-volume testing. It seems the industry might be at a transformation point, with new technology-based BMs emerging (Lehoux et al. 2014). Future research should evaluate if and how the BMs of this industry transform.

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Appendix E. Continuous Business Model Innovation and Dynamic Capabilities: The Case of CEWE (P5)

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CONTINUOUS BUSINESS MODEL INNOVATION AND DYNAMIC CAPABILITIES: THE CASE OF CEWE

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Continuously innovating business models is necessary to leverage technological progress but remains a complex challenge for firms. Dynamic capabilities explain how organisations ensure long-term success by continuously transforming. Still, how continuous business model innovation unfolds and how dynamic capabilities might support remains understudied. Therefore, we use a 27-year old longitudinal case study of CEWE. CEWE transformed from an analog B2B2C business to a digital B2C and B2B brand in the photo industry. We derive a process model on continuous business model innovation, which explains how modular business model innovation builds dynamic capabilities and how architectural business model innovation utilises them. We enrich business model innovation and dynamic capabilities research by demonstrating how both enable and build on each other. For practice, we show explicit dynamic capabilities and routines to manifest them that guide firms to successfully navigate their business model innovation journey.

Keywords: Business model innovation; dynamic capability; longitudinal case study; process model.

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Introduction

To cope with an increasing pace of market dynamics, a rising complexity of customer demands, and an increasing speed of technological innovation, companies have to continuously adapt and innovate their business model (BM) (de Reuver *et al*., 2013; El Sawy and Pereira, 2013; Ferreira *et al*., 2013; Massa and Tucci, 2014; Reim *et al*., 2018; Teece, 2017). Business model innovation (BMI) can lead to a competitive advantage and positively affects performance (Chesbrough, 2010; Clauß *et al*., 2019; Demil and Lecocq, 2010; Foss and Saebi, 2017; Tavassoli and Bengtsson, 2018; Wirtz *et al*., 2015). With continuously changing markets and technology, innovating a BM once is insufficient (Chesbrough, 2010). Companies need to continuously innovate their BMs to achieve and maintain a sustainable competitive advantage (Achtenhagen *et al*., 2013; Casadesus-Masanell and Ricart, 2010; Kraus *et al*., 2017).

Technological progress adds pressure on this need for continuous BMI by periodically enabling "truly new business models" (Teece, 2018): Digital photography disrupted existing BMs of firms such as Kodak and Fuji (Koen *et al*., 2011; Komori, 2015; Lucas Jr. and Goh, 2009). The internet, as another example, led to a disruption of BMs by online companies (Cozzolino *et al*., 2018; Teece, 2018; Wirtz *et al*., 2010). Spoiled by the success of the internet, more and more firms built platform-based BMs, effectively outcompeting traditional companies (Baden-Fuller and Haefliger, 2013; Parker *et al*., 2016; Rochet and Tirole, 2006). The notion of multi-sided markets (Rochet and Tirole, 2006) led to the immense success of platform-based BMs. Whereas technological progress can facilitate the development of new BMs (Baden-Fuller and Haefliger, 2013) technology itself has no inherent value (Chesbrough, 2007) but needs to be embedded into BMs to realise its potential (Zott *et al*., 2011). To exploit such potentials, managers need to understand how they can incorporate technology into their BMs (Fichman *et al*., 2014; Rai and Tang, 2014; Veit *et al*., 2014).

However, firms struggle with continuously innovating their BM, as innovating a BM once is already challenging (Johnson *et al*., 2008; Sosna *et al*., 2010), and many fail to do so (Christensen *et al*., 2016). If organisations fail to innovate their BMs repeatedly, they can lose their competitive advantage. Kodak, for example, performed various innovations over decades that put them at the top of the photo industry. Yet, they have not delivered suitable and continuous innovation of their BMs in the digital age, resulting in bankruptcy (Gassmann *et al*., 2014; Lucas Jr. and Goh, 2009). Managers need to understand the bigger picture of this continuous process of BMI and grasp the effect of time to not lose their competitive advantage, as was the case for Kodak.

Research explains how organisations maintain profitability over an extended period with the help of the dynamic capabilities framework (Castiaux, 2012; Fischer *et al*., 2010; Randhawa *et al*., 2020; Teece *et al*., 1997; Teece, 2007). Firms' BM choices depend, among others, on their dynamic capabilities (Teece *et al*., 2016; Teece, 2017). Firms with stronger dynamic capabilities have more freedom to build "radical BMs" and are more effective in implementing BMs (Teece, 2017). Hence, to realise continuous BMI, firms require dynamic capabilities (Randhawa *et al*., 2020). Dynamic capabilities offer a suitable framework to study the phenomena further (Foss and Saebi, 2017).

Although research on BMI and dynamic capabilities provides a solid basis, the problem of firms failing at continuous BMI remains puzzling. We identify, in particular, three research gaps: (1) Existing research provides generic insights on building dynamic capabilities (Teece, 2007), but fails to provide concrete routines on how organisations can develop and utilise specific dynamic capabilities in the context of BMI. Additionally, prior research shows dynamic capabilities lead to the long-term profitability of an organisation (Teece, 2017), but lacks a detailed understanding of which outcomes can be achieved by utilising dynamic capabilities within BMI.

Further, existing research elaborates on an existing interrelation of dynamic capabilities and BMI (Chesbrough, 2010; Foss and Saebi, 2017; Teece, 2017), but (2) the role of dynamic capabilities in the actual process of continuous BMI remains vague (Teece, 2017). It remains understudied how exactly dynamic capabilities are utilised to foster a continuous process of BMI (Foss and Saebi, 2017; Randhawa *et al*., 2020; Ricciardi *et al*., 2016) and what role BMI takes in building and reconfiguring capabilities (Chesbrough, 2010).

Lastly, while research has shown that BMI is essential for organisations, especially with technological progress, and enables them to maintain a competitive advantage, it (3) is unclear how organisations continuously innovate their BM and which activities account for its success. Scholars studied the antecedents and preconditions of BMI, but have difficulties explaining in detail how continuous BMI unfolds over time (Chesbrough *et al*., 2018; Foss and Saebi, 2017; Sjödin *et al*., 2020). Research on BMI needs to study antecedents *and* outcomes of continuous BMI and how sequential BMIs influence each other (Chesbrough, 2010; Foss and Saebi, 2017; Randhawa *et al*., 2020).

Addressing these gaps, we focus on the following research question: *How does the process of continuous business model innovation unfold and what is the role of dynamic capabilities within that process?*

Tackling this question, we conduct a longitudinal single-case study of a prominent player in the European photo industry, CEWE, based on a period of 27 years.

Unlike its failing competitors, such as Kodak, CEWE has survived and continues to thrive in a challenging industry, albeit transformed. CEWE continuously innovated its BMs and has become a multi-brand and market-leading organisation. Using publicly available data, internal data, and interviews, we analyse the innovation of its BMs over 27 years (1994–2020). We uncover a process of how CEWE develops and utilises dynamic capabilities with modular BMI and leverages these capabilities in architectural BMI. We present a process model to explain continuous BMI, incorporating dynamic capabilities. Further, we highlight explicit dynamic capabilities that led to the overall success of the process for our case company, and show routines that support in building and maintaining these capabilities.

We contribute to research on dynamic capabilities, detailing its role as an antecedent to and outcome of BMI. For research on BMI, we provide a process model, specifying in detail how continuous BMI unfolds. For practice, we show how organisations can successfully navigate their journey of continuous BMI and showcase explicit dynamic capabilities that can help the success of this process.

Related Work

Dynamic Capabilities

One concept able to explain organisational actions on strategy, BM, and product-level, is dynamic capabilities. Dynamic capabilities employ a process approach instead of the resource-based view, which uses a rather static stance to explain organisational actions and success based on available resources (Eisenhardt and Martin, 2000). So, while the resource-based view emphasises resource choice, dynamic capabilities emphasise the development, reconfiguration, and renewal of resources to explain an organisation's (further) development (Noman and Basiruddin, 2021).

Organisational capabilities, in general, describe resources used to produce an outcome and are either inherent in individuals or arise from learning, a combination of organisational assets, and acquisitions (Teece, 2016). One can differentiate between ordinary capabilities, which focus on operational and efficiency issues to meet current objectives, and dynamic capabilities. Teece (2016) highlights the difference: "*ordinary capabilities are about doing things right, dynamic capabilities are about doing the right things, at the right time*". Dynamic capabilities refer to a firm's ability to integrate, build, and reconfigure internal competencies to address changes in the business environment (Kump *et al*., 2018; Teece *et al*., 1997; Teece, 2007; Tidd *et al*., 2006). For the remainder of the paper, we will focus on dynamic capabilities.

The dynamic capabilities framework differentiates between microfoundations and high-order capabilities. Microfoundations refer to the use and recombination of existing ordinary capabilities and the development of new ones, e.g., new

product development and, in general, actions that support decision-making under uncertainty (Teece, 2017). High-order capabilities, in turn, refer to capabilities that enable the management to *sense* external developments, e.g., the future use of digital technology (Costa Climent and Haftor, 2021), and to *seize* opportunities by adapting organisational structures and BMs. Further, *transform* refers to a periodic transformation of aspects of an organisation and its culture to address newer opportunities and threats (Teece, 2016; Teece, 2017). When referring to dynamic capabilities, we include microfoundations and high-order capabilities.

Research on dynamic capabilities has taken different streams, elaborating how capabilities manifest themselves in various forms (Eisenhardt and Martin, 2000; Helfat and Raubitschek, 2018; Schilke *et al*., 2018; Vial, 2019). First, research studies how dynamic capabilities are built and how they are formed by various variables (Zahra *et al*., 2006). Scholars in this stream employ a perspective of learning and innovation (Helfat and Peteraf, 2009; Teece, 2007), as dynamic capabilities can be derived from learning processes (Zollo and Winter, 2002). Teece indicates a learning process based on activities of detecting threats and opportunities, coordination activities outlining boundaries, decision-making rules, and building loyalty, as well as reconfiguration activities (Teece, 2007). This stream traces dynamic capabilities to routines, processes, and collective activities. Routines are repeated patterns of interdependent actions (Feldman and Pentland, 2003; Pentland *et al*., 2012) and support to manifest and further build dynamic capabilities (Helfat and Peteraf, 2009). This stream further studies R&D capabilities and the possibility of developing capabilities based on internal R&D processes (Helfat, 1997; Kor and Mahoney, 2005). Indeed, intensive R&D can lead to increased development of dynamic capabilities (Kor and Mahoney, 2005). Further, scholars look at dynamic capabilities related to the position of the firm in the network and its competitive environment. Here, the focus is on alliances and enablers for firms to source knowledge beyond their own boundaries. The learning perspective is extended across organisational boundaries (Rothaermel and Alexandre, 2009; Volberda *et al*., 2010). Additionally, the actual position of a firm in its network, i.e., the national system of innovation as well as its' market competition (Tidd *et al*., 2006), influences its innovation strategy and, as such, influences its' development and use of dynamic capabilities. Extending the view of the position of the firm in the network, more recently, dynamic capabilities are used as a lens to study innovation based on platforms (Helfat and Raubitschek, 2018; Karimi and Walter, 2015; Okano *et al*., 2022; Shi *et al*., 2021; Zeng and Mackay, 2018). Research also studies how dynamic capabilities can be built within focused niches, e.g., for sustainability (Castiaux, 2012). Calls have been made to further engage in how dynamic capabilities are developed and leveraged to innovate (Pentland *et al*., 2012; Schilke *et al*., 2018; Teece, 2007) and further to study the development of dynamic capabilities over time, as this knowledge is valuable, particularly for

practice. Currently, the understanding of the design and use of repeatable mechanisms to build dynamic capabilities is limited (Vial, 2019).

Second, research studies the utilisation of dynamic capabilities. Most scholars within this stream study the alignment of exploration and exploitation (Benner and Tushman, 2003; Lubatkin *et al*., 2006; Raisch *et al*., 2009), often building on ambidexterity as a focus to study dynamic capabilities (O'Reilly and Tushman, 2011). Researchers try to understand how to utilise dynamic capabilities while maintaining a balance of flexibility and efficiency (Eisenhardt *et al*., 2010), stability and change (Farjoun, 2010), and incremental and radical innovation (Tushman *et al*., 2010). Further, the reconfiguration of capabilities (Xie *et al*., 2022) is analysed. Based on this stream, research evolved to understand the utilisation of dynamic capabilities and more general innovation strategies as path-dependent, as, next to the position of the network, a dependency on future possibilities exists (Tidd *et al*., 2006). Research in this stream argues that path dependency can be a property of dynamic capabilities (Vergne and Durand, 2011). As dynamic capabilities utilise organisational processes and routines (Helfat and Peteraf, 2009; Zollo and Winter, 2002), these routines and their manifestation can become path-dependent by the effects of self-reinforcing mechanisms (Vergne and Durand, 2011). While it is clear that remaining balance plays a crucial role in utilising dynamic capabilities, it remains unclear which dynamic capabilities can be utilised to achieve certain outcomes and how specifically that utilisation can look. Additionally, which capabilities help respond to threats and how these capabilities can be manifested remains vague.

Third, scholars look at the outcome of utilising dynamic capabilities. Typically, the outcomes of utilising capabilities can be innovation, the maintenance of a competitive advantage, and the ability to respond to threats (Noman and Basiruddin, 2021; Randhawa *et al*., 2020; Teece, 2007). Further, capabilities can not only be built by R&D, but also can foster R&D to achieve more radical innovation and to exploit better knowledge stemming from R&D to increase long-term returns of innovation (Denicolai *et al*., 2016). However, the actual outcomes of dynamic capabilities are often generic or unclear. It remains vague how competitive advantage (e.g., higher revenues, better quality, higher market share) is achieved by utilising dynamic capabilities, how it can be maintained, and how dynamic capabilities support responding to threats.

Business Models and Business Model Innovation

Business Models

The concept of BM has gained increasing momentum since the mid-1990 in research and practice (Budler *et al*., 2021; Wirtz *et al*., 2015; Zott *et al*., 2011).

Still, scholars do not agree on what a BM is and provide various definitions of the concept, leading to a lack of clarity (Budler *et al*., 2021; Foss and Saebi, 2017; Zott *et al*., 2011). With increasing interest, different schools of thought emerged, resulting in different interpretations of the concept of BMs (Massa *et al*., 2017; Wirtz *et al*., 2015). Construct validity in BM research requires engaging with existing conceptualisations and positioning one's own research (Bagozzi *et al*., 1991).

Three fundamentally different interpretations exist: BMs (1) as an attribute of real firms, (2) as a cognitive/linguistic schema, and (3) as a formal, conceptual representation describing the activities of a firm (Massa *et al*., 2017). The first interpretation uses the concept to study how BMs of real firms work by a composition of variables (Abdelkafi *et al*., 2013; Bohnsack *et al*., 2014, 2021; Casadesus-Masanell and Zhu, 2010; Laukkanen and Patala, 2014; Remane *et al*., 2017). The central idea of the second interpretation is that managers make decisions based on images of a real system (i.e., the BM) but not the real system itself (Amit and Zott, 2015; Martins *et al*., 2015; Massa *et al*., 2017). The third interpretation explicitly writes down formal models to reduce complexity (Massa *et al*., 2017). A widelyknown example of this interpretation is the Business Model Canvas and its complementing works, providing meta-models of BMs (Osterwalder *et al*., 2005; Osterwalder and Pigneur, 2010; Osterwalder and Pigneur, 2013).

For our research, we adhere to the first interpretation, seeing BMs as attributes of real firms. With that, we follow one of the central themes of BM research, using a system-level approach to study how organisations do business (Zott *et al*., 2011). Further, we follow the seemingly growing consensus (Costa Climent and Haftor, 2021; Massa *et al*., 2017) to view a BM as the design and architecture of how a business creates, delivers, and captures value (Osterwalder and Pigneur, 2010; Teece, 2017) and act on the firm-level for our analysis.

Next to these three interpretations, scholars use different views on BMs over all three interpretations: a static and a dynamic view (Demil and Lecocq, 2010; Wirtz *et al*., 2015). The static view incorporates representations of BMs based on components. The dynamic view embraces change and innovation of and in BMs. We use the static view to describe the components constituting CEWE's BMs at certain points of time. This approach supports us in setting out the key characteristics of our unit of analysis to allow progress in research (Foss and Saebi, 2017). Wirtz *et al*. (2015) stress the heterogeneity of constituting components of BMs in different conceptualisations. However, the main components of the widely used BM representations (Teece, 2010) and practitioner-oriented approaches, such as the Business Model Canvas (Osterwalder and Pigneur, 2010) or the Business Model Navigator (Gassmann *et al*., 2013), can be aggregated into four distinctive components using different terminology: value proposition, market segments, value

Table 1. Business model components.

Element	Constituting components
Value proposition	Value proposition, offering, products and services, brand
Market segments	Market segments, customers (B2X)
Value creation	Partners, resources, activities, customer relationships, channels
Value capture	Revenue streams, cost structure, investments, financial viability

creation, and value capture mechanisms (Foss and Saebi, 2017; Saebi *et al*., 2016; Teece, 2010; Weking *et al*., 2020) (Table 1).

The second, dynamic view, uses "*the concept as a tool to address change and innovation in the organisation, or the model itself*" (Demil and Lecocq, 2010). This dynamic view aims to understand a firm's activities employed to change between different BMs and the mechanisms for value creation and capture (Cavalcante *et al*., 2011; Demil and Lecocq, 2010; Ritter and Lettl, 2018; Zott *et al*., 2011). We use that dynamic view to understand how the components of a BM are adapted or redesigned between different points of time. Indeed, innovation, change, and evolution have become essential research foci on BMs (Wirtz *et al*., 2015).

Business Model Innovation

In the following, we understand BMI as "*designed, novel, nontrivial changes to the key elements of a firm's BM and/or the architecture linking these elements*" (Foss and Saebi, 2017). Following this definition, we view BMI as "deliberate" changes (Demil and Lecocq, 2010). Deliberate implies that a manager or an organisation purposefully takes a decision, which results in the activity of BMI. Some scholars understand BMI to take place in one single component of a BM (Amit and Zott, 2012; Bock *et al*., 2012; Schneider and Spieth, 2013). Other scholars stress that one or several components need to be changed (Frankenberger *et al*., 2013; Günzel and Holm, 2013; Lindgardt *et al*., 2009), while further scholars require novel combinations (Velamuri *et al*., 2013; Yunus *et al*., 2010).

To study business model innovation, we follow the distinction of Foss and Saebi (2017). A modular BMI refers to an evolutionary and focused BMI, innovating one or a few components of a BM. As such, an organisation runs the same business model but innovates the way how it is operated (e.g., the process or technology). The existing business model is adapted, yet no entirely new model is brought to the market. This is largely similar to "product", "process", or "position innovations" (Tidd *et al*., 2006), with changes in one or few business model components. An architectural BMI refers to an adaptive and complex BMI, innovating several BM

components simultaneously. With an architectural BMI, an organisation changes its business model itself, offering a new business model on the market, and may even lead to a "paradigm innovation" (Tidd *et al*., 2006). Table A.1 in the appendix summarises the different definitions used throughout this research.

BMI in successful firms aims to re-design value creation and redefine value propositions for various stakeholders. Organisations that innovate their BM profit from positive performance (Clauß *et al*., 2019; Cucculelli and Bettinelli, 2015; Tavassoli and Bengtsson, 2018; Zhang *et al*., 2021). However, an organisation and its BMs need to keep up with changing conditions (Ferreira *et al*., 2013; Massa and Tucci, 2014; Reim *et al*., 2018; Wu and Nguyen, 2019). Further, as Chesbrough (2007) demonstrated, technology per se has no inherent value. Instead, it needs to be embedded into products, services, and subsequently into BMs to realise its potential (Zott *et al*., 2011).

An emerging research focus looks at BM dynamics or change, with different framings such as "learning", "reconfiguration", or "evolution" (Berends *et al*., 2016; Demil and Lecocq, 2010; Foss and Saebi, 2018; Sosna *et al*., 2010). As priorly introduced, we refer to BMI as deliberate changes. In the following, we will refer to continuous BMI as an ongoing process constituted of various activities to innovate one or several components of a BM repetitively over time. This research stream implies that one-time BMI is insufficient to ensure a long-lasting competitive advantage (Randhawa *et al*., 2020) and studies BMI as an organisational change process, e.g., identifying different capabilities to support the process (e.g., Achtenhagen *et al*., 2013; Demil and Lecocq, 2010; Doz and Kosonen, 2010). Scholars in this stream acknowledge the importance of experimentation and learning in that process (Andries *et al*., 2013; Eppler *et al*., 2011; Günzel and Holm, 2013; Sosna *et al*., 2010) and elaborate on the necessity to adapt and align value creation and value capture (Foss and Saebi, 2018; Ritter and Lettl, 2018), as BMI is subject to inertia with time (Foss and Saebi, 2017).

Prior literature on business model innovation focused on antecedents and preconditions of BMI, but less on how it unfolds in practice over time and its' outcomes (Chesbrough *et al*., 2018; Foss and Saebi, 2017; Sjödin *et al*., 2020). Research on BMI needs to study antecedents and outcomes, as well as how continuous BMI unfolds in practice in detail (Chesbrough, 2010; Foss and Saebi, 2017; Sjödin *et al*., 2020).

Dynamic Capabilities and Business Model Innovation

Dynamic capabilities and BMI are interrelated. Foss and Saebi (2017) stress investigating the role of dynamic capabilities as drivers of BMI, and Teece (2017)

suggests studying BMI to understand dynamic capabilities in more detail. Prior research conceptualised dynamic capabilities as a driver of BMI in different forms (Achtenhagen *et al*., 2013; Heider *et al*., 2020; Randhawa *et al*., 2020; Teece, 2017). Dynamic capabilities account for an organisation's ability to maintain profitability over a longer period, including designing and adjusting BMs (Teece, 2017). Further, an organisation's choices regarding its BM depend on its dynamic capabilities (Teece *et al*., 2016). Organisations with stronger dynamic capabilities have been acknowledged to have more freedom to build BMs that entail a radical change and to implement effective BMs (Teece, 2017). Thus, dynamic capabilities are antecedent to BMI and enable it (Achtenhagen *et al*., 2013; Soluk *et al*., 2021). Further, the effects of BMI have been described priorly to affect dynamic capabilities (Schneider and Spieth, 2014). Dynamic capabilities support the scaling of BMs (Sandberg and Hultberg, 2021) and are a key driver to innovate a BM continuously (Ricciardi *et al*., 2016), and organisations need to develop and maintain them to address change in their BMs (Cavalcante, 2014).

Additionally, research proposed BMI as a dynamic capability itself. BM design has been characterised as a dynamic capability (Amit and Zott, 2016). On a broader scale, the ability "*to select, adapt, and match the BM and the environment is a capability*" (Teece, 2017). Contradictorily, dynamic capabilities have been described as dependent on the organisational flexibility allowed by BM choices (Teece, 2017). This falls in line with the discussion about the changing conception of dynamic capabilities by Peteraf and Haridimos (2017), with organisations' ability to change their resources based on these capabilities. Existing capabilities need to be reconfigured when innovating a BM to address changing conditions (Chesbrough, 2010; Randhawa *et al*., 2020).

While prior research showed dynamic capabilities and BMI are related, it conceptualises the interrelation differently. Dynamic capabilities account for an organisation's long-term profitability, are conceptualised as a key driver for continuously innovating a BM (Ricciardi *et al*., 2016), and need to be reconfigured when innovating a BM (Randhawa *et al*., 2020). However, prior research does not manage to explain in detail what role dynamic capabilities take in continuous BMI to achieve long-term profitability but rather elaborates on their importance ("key driver"). Further, how capabilities can be reconfigured or developed along continuous BMI remains unclear and requires further research (Foss and Saebi, 2017; Teece, 2017).

Research Design

We employ a single, in-depth, longitudinal, exploratory, and inductive case study design, with the aim of closing "gaps and holes" in the existing theory (Pan and

Tan, 2011; Ridder, 2017). We use a four-phase approach to conduct our case study (Fig. 1). Central to our research design is a two-part process study. First, we perform a descriptive and deductive study of how CEWE innovated its BMs. Then, we follow an inductive approach to analyse why certain activities were performed, which triggers occurred, what outcomes are created, how capabilities are developed and/or employed, and, more generally, why the overall process seems successful in our case.

In phase one, we select a conceptual framework (Dul and Hak, 2008; Yin, 2018). For the deductive part of our research—understanding which BMs CEWE used over time—we use an architectural BM definition, clustered into four dimensions, see Table 1 (Weking *et al*., 2020). We theoretically sampled our case, i.e., we selected the case as it is particularly suitable for the research relations among the constructs of interest, in our case, the continuous innovation of BMs over a long time, impacted by technology (Eisenhardt and Graebner, 2007). We then develop a data collection strategy, building on different elicitation methods to create different types of data and multiple data sources to enable the triangulation of findings and to support assertions about interpretations (Yin, 2014). Combining different data types, i.e., qualitative and quantitative evidence, can also prove synergistic (Eisenhardt, 1989).

The second phase focuses on data collection and analysis. We use publicly available information and internal data sources to collect data, conduct interviews, and perform on-site visits. Our primary data sources are interviews, annual reports provided by the company for the entire analysis period, and investor relation-related publications. Direct observations during a company tour by a local manager enable us to obtain a more detailed and vivid understanding of the case. To allow us to create a deep and nuanced account of the case (Schultze and Avital, 2011) and focus

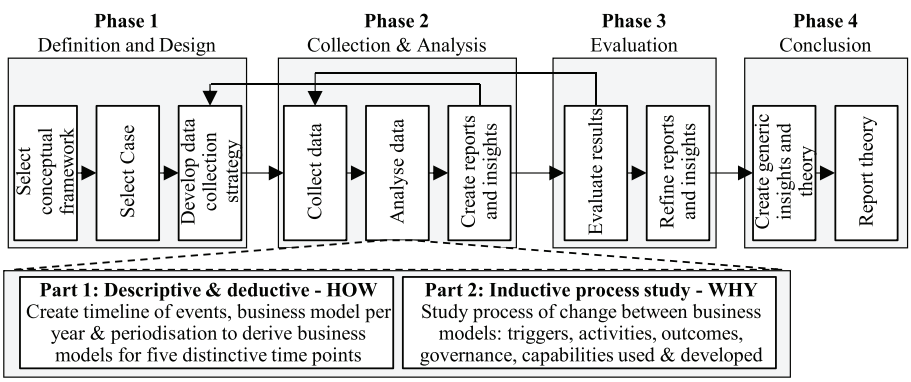


Fig. 1. Research phases of the case study approach (adapted from Grace *et al*. (2019)).

on questions of how and why CEWE engaged in certain activities, we conducted interviews, mainly with long-term employees, which enabled us to elaborate on the entire period of our analysis (Table 2).

We conducted the interviews in the native language of the interview partners and used semi-structured interview guidelines. To embrace the depth and richness of the data, we used an exploratory stance by iteratively revising our interview guidelines based on insights from previous interviews. We transcribed every interview according to the rules of Dresing and Pehl (2018) and verified each transcript with the interviewee. Next to the interviews, we used annual reports, company publications, and internal presentations for triangulation, especially for events that occurred more than five years ago. Secondary data include publicly available data accessible from the company homepage and the press/media archive (see Table 3).

Table 2. Overview of interviews conducted.

ID	Interview partner	Company affiliation (by 2021)	Length of interview
1	Managing director company site & managing director of a subsidiary company	20 years	First interview: 75 min
2			Second interview: 40 min
3	Commercial manager/CFO company site	27 years	First interview: 40 min
4			Second interview: 55 min
5	Technical director/COO & CPO company site	27 years	45 min
6	Head of logistics company site	19 years	38 min
7	Head of customer support for the regional market	12 years	60 min
8	Marketing team leader	3 years	45 min

Table 3. Data sources.

Type of data source	Yearly coverage	Number of publications
Official annual reports (publicly available since 2006)	1994–2019	26
Official quarterly report	2006–2020	44
Official press releases	2016–2020	272
Official investor relations news	2016–2020	41
Official investor relations ad-hoc releases	2006–2020	51
Official investor relations presentations	2009–2018	44
Company presentations	2003–2020	13
Official company factsheets	2020	5
Scientific publications referring to the case company (mostly on production technology)	2008–2016	12

Our data analysis is twofold, building on a process study. This research approach enables one to study how and why organisational phenomena emerge and develop over time, building on empirically evolving phenomena (Langley, 1999). We use this process lens (Langley, 1999; Langley *et al*., 2013), as it allows us to study the causes and outcomes of the continuous BMI of CEWE and the causal relationships of how it unfolded (Markus and Robey, 1988). To first understand the different BMs CEWE employed over time, we use an architectural (i.e., component-based) BM description, see Table 1. We code the BMs for each year chronologically. Further, we note down all activities CEWE engaged in and which events occurred during that year. We observe distinctive BMs between specific points of time. To reduce complexity, we employ periodisation, dividing the chronological narrative and BMs into distinct episodes (Cornelissen, 2017; Langley, 1999; Witkowski and Jones, 2006). This supports the strengths of a case study, being a "good story" and setting out constructs from that story (Dyer and Wilkins, 1991).

In the second step, we use an inductive approach to focus on how and why CEWE innovated its business models. We perform open, axial, and selective coding (Corbin and Strauss, 1990; Glaser and Strauss, 2008) on available data sources and the already coded activities and events from the deductive step. The "how" includes studying which BMI CEWE engaged in and what kind of BMI (modular or architectural) each identified BMI represented. After the open and axial coding, we focus on *activities* and *triggers* that start new activities with selective coding. Further, we focus on *outcomes* of specific activities (e.g., "new organisational unit"), that accompanied the *activities* to reach particular outcomes, e.g., governance structures, external support of further aspects such as tools used. Following this approach, we identify a series of activities linked together, triggers, and capabilities leading to certain outcomes for each of these activities. Following the principle of constant comparison (Urquhart *et al*., 2010), we alternated between data collection and analysis (as evaluation, see phase 3 in Fig. 1), examining additionally collected data in the light of other developed codes and extant literature.

In the last step, we focus on generalising the case-specific results. We develop a process model for continuous BMI based on our process lens. The model builds on dynamic capabilities. We deliberately focus on the essential characteristics observed within our process study, allowing parsimony and generality while still aiming to provide a comprehensive theory (Langley, 1999; Suddaby, 2010). The rich case description allows understanding various aspects of the model in detail. However, in its pure simplicity, the process model describes how continuous BMI unfolds and what role dynamic capabilities take in that process.

The Continuous Business Model Innovation of CEWE from 1994 to 2020

The photo industry and CEWE's role in 1994

In the mid-1990s, digital imaging technologies and digital photography emerged to disrupt hardware manufacturers (camera and film) and service providers (photofinishing and printing). Until then, laboratories produced prints from a photographic film using a chemical process. Photographers sent their films to laboratories either directly or through a retail partner. By 2003, digital cameras had surpassed analog cameras in sales (van der Aalst, 2016). Photos were now being stored on digital media and could be viewed directly on digital screens. As a result, consumers no longer required printed images. Although, with the onset of digital printers, it was also possible to make physical copies of digital photographs. The cost of high-quality digital prints in small quantities soon fell, especially when compared to offset printing, leading to a drop in the turnover of photo laboratories. From 2011, sales of digital cameras began to decrease due to the rise of smartphones and their photographic capabilities (CEWE, 2018). Nowadays, the majority of pictures are taken *via* smartphones. Hence, traditional hardware manufacturers and service providers had to rethink their BM. While prominent players like Kodak went out of business, CEWE succeeded and is now the market leader in the European photofinishing industry.

CEWE was founded in Germany in 1961 as a photo laboratory and a retail operation for photographic equipment. CEWE's core business relied on consumers placing in-shop orders with the help of retail partners, who forwarded the orders to the laboratory for developing and printing. The organisation has around 4,000 employees and had a turnover of approximately 727 million EUR in 2020. The company is the market leader in Europe in the photo finishing industry. CEWE became a publicly listed company in 1993, enabling it to generate capital to start its digital transformation. This situation frames the starting point of our analysis in 1994.

In 1994, CEWE relied on retail partners, who took orders from end consumers (B2B2C). Its core know-how was technical and related to the company's production processes. Retail partners sent a consumer's film rolls to CEWE, which printed the photographs and returned them to the retail partner. CEWE was a white-label brand, generally unknown to end consumers. Nevertheless, with over 20 production sites around Europe, the company was the market leader in the photo-finishing industry in Europe in 1994. In addition, the company had a direct B2C hardware segment, which was, and still is, minor in revenues. CEWE operates its own retail stores where it sells hardware, i.e., cameras and accessories, to end consumers,

Table 4. CEWE's business model in the year 1994.

Value Proposition		**Value Creation**	
• High-quality photos • Fast delivery • Technological leader	• White label brand • Specialist in photographic hardware	• Logistics partners for sending shipments	• Own hardware stores • Photographic printing in own laboratories
Market Segments		**Value Capture**	
• Retail partners as points of sale (B2B2C) to private consumers • Mass-market orientation in 11 European countries	• Direct contact to consumers only in hardware stores • Professional photographers as commercial customers	• Costs of personnel, production processes, and technology • IPO provides funds for investments	• Revenue-based on fixed service prices • Revenue from photofinishing and hardware retail

mostly professional photographers. In 1994, it had stores in Slovakia, the Czech Republic, and in the city of Oldenburg in Germany, the company's headquarters. Table 4 sets out the company's BM as of 1994.

Business models and episodes during CEWE's continuous business model innovation

We structure CEWE's BMI along four episodes with different foci. Each episode starts with BMs (CEWE operated multiple BMs in parallel) at a certain point of time t (e.g., $t = 1$), incorporates various activities of modular BMI that lead to architectural BMI and a new BM $t + 1$ (e.g., $t = 2$). To showcase *how* CEWE continuously innovated its BMs and *why* it was successful, we focus on the activities performed between the timepoints $t = 1$ to $t = 5$. Figure 2 provides an overview of the BMs between the four episodes.

In 1994, CEWE operated two BMs: a B2B2C model as a white label brand (the production of photos and sales *via* retail partners) and a B2C hardware retail model (sales of photographic equipment to mostly professional photographers). As the only significant changes to the hardware retail model refer to entering new geographical markets, we focus on the core BM, the production and sales of photo copies. While CEWE created value through the physical process of producing pictures in laboratories, it enabled fast delivery utilising its 24 production sites around Europe in 1996 (annual report 1996). Hence, CEWE had contracts with partners, who are the face towards the consumer to capture value.

By $t = 2$, CEWE offered the first B2C services BM. While this new BM only accounted for minor revenues, this, for the first time, provided an entirely new logic compared to CEWE's existing BMs. By $t = 3$ CEWE invested more into technology and developed a consumer brand with the new leading product, the CEWE PhotoBook, offering a B2C BM. CEWE not only sold the PhotoBook directly

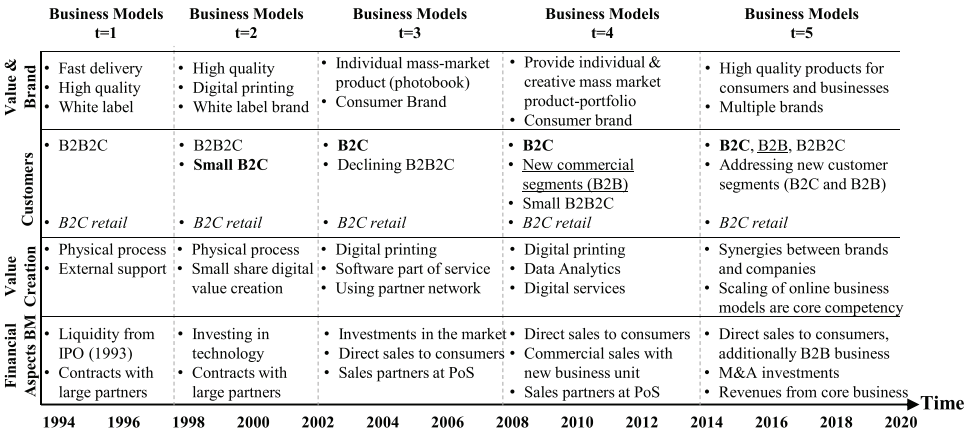


Fig. 2. Business models offered by CEWE since 1994.

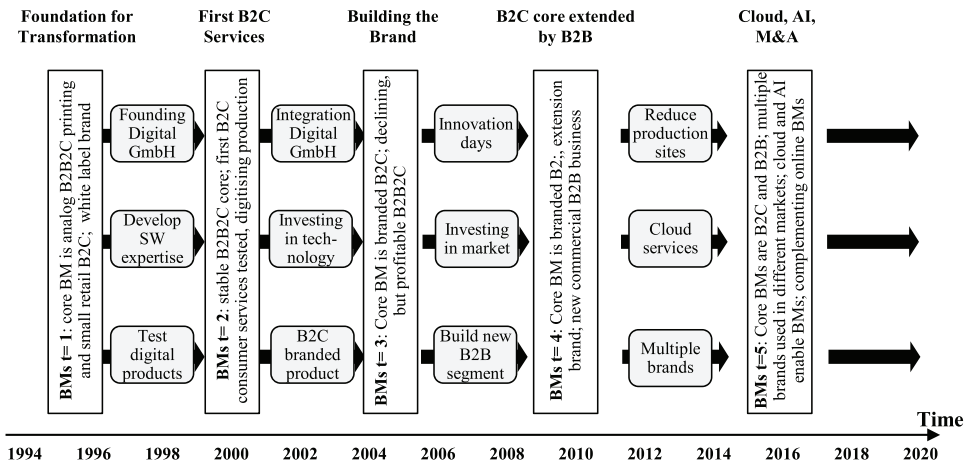


Fig. 3. Four episodes in CEWE's continuous business model innovation from 1994 to 2020.

via its digital sales channels but also through existing Point of Sale (POS) retail partners and pick-up locations (B2B2C). With $t = 4$, CEWE added commercial online printing as a B2B BM to the existing photo finishing B2C and the B2B2C retail hardware business. Within the last episode of analysis $t = 5$, CEWE decided to operate different BMs at different subsidiaries. Next, we focus on how and why these BMs changed, i.e., how CEWE performed continuous BMI activities and why these were successful.

Episode 1: Testing first B2C services (BM t = 1 → BM t = 2)

Based on the initial BMs in 1994, CEWE adapted its existing BM by modular BMIs. To enhance *value creation*, the CEO developed new competencies, despite the low relevance of new technologies such as digital photography: "*CEWE […] is expanding its expertise in digital photography, although this is still a niche market* […]" (annual report 1996). It was still unknown if and how new technologies such as digital imaging would transform the market segment (annual report 1996, 1998). However, based on reports of that time, the relevance of digital photo technology seemed to be low: "*Digital photography is still practically non-existent in amateur photography* […]" (annual report 1995).

In 1994, CEWE tested the first printer able to print digitally stored images. A *Picture-CD* further aimed to use digital storage means, even though its relevance seemed to be decreasing after the market introduction: "*The photo CD business is stagnating at only a 'moderately' interesting level. The image data carrier is a niche product [....]. We have consolidated production [...] at a single site*" (annual report 1996). In 1997, CEWE installed the first on-site *Photo Kiosk*, a machine to place orders in retail partners' stores to produce pictures. The on-site machine reduced transaction costs and shortened the processing time of photofinishing.

Further, with the help of external support from an IT company, CEWE developed and introduced the *PhotoIndex.* The *PhotoIndex* showed all photos from a film roll on a single sheet, enabled by software and digitising of pictures. This product eased the process of archiving and re-ordering photos and created additional revenue: "[….] *it makes it easier to archive films and reorder photos, which we notice in a sharp increase in reorder business. This also generates additional sales for our retail partners and for us*" (annual report 1996). By 1997, it evolved to the market standard: "*We have enforced the PhotoIndex, [….], as a market standard in 1997*." (annual report 1997). With this new product, CEWE adapted the existing BM to enable additional after-sales business.

Until then, CEWE adapted its existing BM, including its product, but did not offer a new BM. Despite the missing relevance of digital photography, the use of CDs as memory storage, and the use of the internet for consumers, CEWE's CEO still insisted on further building on these technologies. Even though this decision was attached to high uncertainty, he felt the technologies' relevance might increase in the future. Consequently, he initiated two innovation activities: founding a subsidiary dedicated to digital themes and engaging with end customers directly that affected CEWE's whole BM (i.e., architectural BMI), resulting in new BMs in $t = 2$.

First, the CEO installed a new subsidiary company that focused purely on digital themes ("Digital GmbH") and drove new developments independently of

day-to-day business: "*We had the opportunity […] and […] resources to set up an independent department that could deal with the topic of digital, and the use of digital data to produce prints. Under the leadership of our current CTO, an independent company within the organisation was founded that could drive these developments forward, totally independently from ongoing transformations within the company sites*." (ID 4). This subsidiary fostered fast decision-making without involving the core business. CEWE aimed to employ a new workforce with knowledge in the digital field to develop internal know-how and capabilities. Moreover, the unit encouraged entrepreneurial spirit and created, tested, and rolled out new, technology-based BMs parallel to the day-to-day business.

Second, CEWE engaged in direct customer contact, offering a B2C BM. In 1996, CEWE still elaborated on the importance of their long-lasting partnerships and avoided direct interactions with consumers: "*CEWE will continue to be a partner of the retail trade in all its forms and will not seek the direct route to the consumer. CEWE will therefore not engage in any mail order or direct sales activities in its traditional sales region.*" (Annual report 1996). However, by 1998 this strategy changed, as the management team introduced B2C services (digital and analog ones) and enabled mail orders. For the first time, CEWE introduced a B2C BM besides its small-scale hardware business.

Episode 2: Switching to B2C business and building the brand (BM $t = 2 \rightarrow$ BM $t = 3$)

During the next episode, CEWE innovated specific parts of their BMs by modular BMIs shifting toward digital technologies. During the start of this episode, CEWE relied on software to organise production and installed digital printers, and digitised the production of photos itself (annual report 1999). Based on the *Photo Kiosk,* introduced in 1997, CEWE launched the *PhotoMaker* as its first mass-market product for consumers and installed it in retail-partner stores. This innovation enabled to offer new value propositions and new customer channels: "*The customer […] needs possibilities to provide his pictures either at the Point of Sale […] or even from his own home.*" (ID 5). In addition, customers could individualise their products in the form of […] *order pictures, but also greeting cards, calendars, and other products on the screen with a simple touch-screen operation*" (Annual report 1999).

Moreover, driven by the Digital GmbH, CEWE tested and introduced "*digital services at CEWE*" (annual report 2000). These services did not necessarily include the production of physical pictures. With the *Picture CD*, CEWE added for the first time—a software to their product. The *Picture CD* included editing software along

with the provided pictures (annual report 1998). Additionally, *PhotoNet* directly targeted consumers, allowing them to save their photographs online and "*present them to friends*" (annual report 1998). It followed the same principle as the *Picture CD*, but used the internet to offer a new consumer service.

In 1999, CEWE introduced *Photoworld,* an internet-based service enabling photo retailers to market their services *via* the internet, while CEWE is responsible for updating and maintaining the system. Developed in collaboration with external support from an IT organisation, *Photoworld* created recurring revenues for CEWE. Via *Photoworld*, customers could order online, which usually took place on a partner's site hosted within this service (annual report 2000). Hence, this new service not only relied on the physical production of pictures but also opened additional sales channels *via* partners to increase the number of orders, enhancing the existing BM.

Based on the various experiences with new digital technologies, the management realised a dedicated exchange of ideas around the topic "digital" was necessary and decided to set up a "digital circle." It was a weekly meeting of employees from different departments, including the CEO, to discuss current trends focusing on innovation: "*there were various experiments to introduce the digital into our business*" (ID 5). On the one hand, this continuous process fostered the generation of ideas. On the other hand, it eased the integration of ideas from the Digital GmbH subsidiary into the mother company. By capturing various experiences and ideas for different departments, the digital circle also created a shared commitment and quickly established a weekly routine.

Despite the various modular BMIs performed, CEWE's management started to sense that technological innovations on products or processes might not be sufficient. First, bargain power lay with retailers, and competition was fierce, leading to dropping margins of photo production. Based on the still predominant B2B2C BM, CEWE was highly dependent on its partners and subject to their bargaining power. Second, CEWE realised the digital trend early on, and their investment into digital technologies, e.g., digital printers or the photo kiosk to transmit digital saved image data, turned out successful, even if revenue shares were minor but steadily growing. Third, sales of digital cameras increased, and more computers gained the ability to display digital pictures, which turned printed pictures obsolete: "*At this point in time, the customer does not really need us anymore*" (ID 3). Due to these developments, CEWE realised that new products and services were necessary to ensure that pictures continued to be produced and consumed physically or build entirely new services around pure digitally consumed pictures.

As a result of these factors, CEWE introduced an internet-based service, *PhotoWorld*. Based on the positive feedback regarding individualised products, CEWE observed that this offering was continuously growing. In addition, the introduction of the *Picture CD*, along with further innovations such as the

digifilm maker, brought about new possibilities. CEWE realised that digital data became available with these mediums, and they could learn insights about consumer behaviour. These insights ranged from the time between taking and printing a picture, to the content of ordered pictures, and which photo is printed if the same motive was shot multiple times. As a result, CEWE started to emphasise consumer behaviour analysis, realising the value of these insights.

This mixture of external pressure, technological developments, and newly developed internal capabilities led to a key decision in the continuous innovation of CEWE's BMs. Resulting from ideas of the Digital GmbH and the "digital circle," CEWE decided to offer an entirely new B2C BM based (i.e., architectural BMI) on a new product that directly targets consumers and leverages know-how about consumers and digital technologies: The *CEWE PhotoBook*. With this new product, CEWE changed its core logic of doing business. To this end, CEWE's top management decided on three activities. First, CEWE hired IT professionals on a large scale to accelerate the development of know-how and subsequent digital products: "*A lot happened from the inside. The decision-making […]to somehow hire over 200 IT professionals to produce our own software first as the basis for the production of books and other products, was quite crucial*" (ID 4). IT professionals worked on digital products and on operations and production. Second, the increasing relevance of digital for CEWE's business led to the decision to reincorporate the subsidiary Digital GmbH in 2004: "*[…] We noticed that this initially marginal or partial business then became a central business*" (*ID* 3). Third, to counteract price wars and decreasing margins due to CEWE's dependency on a B2B2C BM, the CEO decided that CEWE should act as a consumer brand, moving away from a white-label: "*And then, with our CEO, came the clear focus on brand strategy, which should prevent us from being suddenly bathed in a price war […]*" (ID 5). This mixture of activities and capabilities triggers the third episode with a B2C BM and brand strategy as the organisation's core.

Episode 3: Building B2B (BM t = 3 → BM t = 4)

During the third episode, CEWE engaged in different initiatives on specific parts of their BM to support growing the branded and consumer-oriented BM (i.e., modular BMI). The priorly introduced B2C BM became the organisation's core and required a new organisational thinking. The CEO enabled this new organisational thinking by transforming from a production-oriented company into a digital marketing organisation, placing market research and marketing at the center of product development. CEWE shifted its investment logic from resources and technology towards investing primarily in the market itself. Most investments targeted opening up and expanding the market for the first time in the company's history.

Based on the core product *CEWE PhotoBook,* CEWE successfully operated and grew its new core BM of B2C. During that period, the management realised that various modular innovations stemmed from the cross-functional formats such as the digital circle introduced in the second episode (meanwhile known as the "innovation circle": "*But I would also say that the major guidelines in the company always go through […] the innovation circle*" (ID 2). Sensing this potential, CEWE took the same principle to a broader level by introducing "innovation days," during which all departments, hierarchies, and sites came together. The goal was to create an organisation-wide communication and cross-disciplinary innovation. "*The innovation days […] are extremely important. […] because all the important decision-makers sit around the table.*" (ID 2).

Despite the success of the new BM, CEWE realised that consumers use the photobook mainly to create a personalised book with pictures from a vacation, a special occasion like a wedding, or, most often, a year's review. This makes the product a popular Christmas gift. As a result, the product is highly cyclical: The fourth quarter accounts for almost half of the annual turnover in 2008. However, personnel and production capacities remain barely used during months of low demand.

CEWE realised that a new BM was necessary to utilise unused resources and keep growing. The management used their available resources and experiences and performed an architectural BMI to offer an entirely new BM, directly addressing business customers (B2B). The success of the B2C business allowed investments, as it "*[…] has given us the freedom to breathe, to do what we are doing today: communicating our brand.*" (ID 3). In addition, CEWE developed specialised knowledge on digital printing and has grown a large network of partners over the past decade (e.g., for logistics). Based on this untapped potential, CEWE introduced in 2008, an entirely new BM addressing the B2B segment: "*We are making digital printing suitable for the mass market—and are using our know-how from the photo market. […] Commercial digital printing is the growth area for the future*." (CEWE's annual report 2009). CEWE acquired *diron* in 2008, a web-to-print software company, to start this segment. The new "commercial online printing" BM produces made-to-order B2B products (e.g., schoolbooks) as "web-to-print," especially during the low demand period of the year. The acquisition of *saxoprint* in 2012, a specialist in online-connected offset printing, further aimed "*to achieve economies of scale through industrially efficient production*" (annual report 2011).

Episode 4: Multiple brands and cloud & AI (BM t = 4 → BM t = 5)

Within the fourth episode, CEWE performed various modular BMIs. The organisation further built its brand to nourish its core business, establishing it in the European market with the photobook launched previously. CEWE's marketing

now enabled cross- and up-selling activities. In the consumer sector, products and services are continuously adapted and advanced, extending the product portfolio: photobooks, postcards, calendars, posters, phone cases, mugs, and photo-related gifts. CEWE also extended its digital channels. It offers online tutorials and webinars to familiarise its core customer segment, to a large part of middle-aged women, with its products and services. In 2010, CEWE introduced its first mobile phone app, offering new channels for its existing BMs.

Additionally, CEWE developed extensive know-how in digital technologies and data analytics. The management decided to introduce new cloud-based services and further build on data analytics to leverage this know-how. While mobile apps have been in place before, cloud-based services created recurring revenue streams by subscription models and after-sales services. At the same time, data analytics supported switching the logic of ordering photo products from pull (consumers create a photobook) to push (the consumer automatically gets a digital, fully prepared photobook ready to order). In 2015, CEWE launched *myphotos*, a cloud-based storage solution for saving and sharing pictures and enabling direct ordering of photos or a photobook. CEWE leveraged its developed capabilities and offered a freemium model for the first time: A basic contingent of storage is free. If a user requires additional storage, a fee applies. Furthermore, consumers can share digital photo compilations with friends for special occasions such as weddings. By that, also non-customers of CEWE can be addressed to buy, e.g., a photobook, as the product is digitally visible and ready to order. With technological advancements in face and object recognition, "photobook on command" (Company Presentation August 2020) becomes possible.

However, CEWE's association with high quality made it difficult to allow different pricing models within different sectors and customer segments. A "low-cost" service with the core brand could harm the high-quality image. CEWE realised that other brands were necessary for various B2C and B2B segments. Combined with the availability of capital, CEWE decided to enhance its organic growth with adjacent growth based on acquisitions to strengthen its competencies and enter new market segments. Introducing new or takeover of existing brands led to a portfolio of multiple brands, addressing heterogeneous customer segments. The various acquisitions enabled new value propositions, addressed new consumer segments, and employed different pricing strategies in the commercial sector without harming the core brand and its association with high quality. For example, CEWE acquired *Cheerz* in 2018 and *White Wall* in 2019. *Cheerz* is the market-leading photo printing app in France, Spain, and Italy and allows the company to address a new customer group: the millennial generation.

To foster value creation, CEWE used its newly developed competencies from previous integrations (e.g., *diron* 2008) to integrate and scale new companies. At

the same time, CEWE created synergies: "*This [the exchange with acquired companies] also has something beneficial for CEWE. We are also learning how to be successful.*" (ID 7). Acquisitions were not fully integrated to use decentralised competencies: "*If you meet someone who is more professionally positioned, maybe only for a certain market segment, I think it would be fatal to make the mistake […], to integrate these companies 100* percent. *Bur rather exchange the know-how* […]" (ID 5). Further fostering the full potential, CEWE used the same principle as in 2002 and introduced "digital circles" within so-called "expert circles" to regularly discuss specific topics and exchange experiences beyond the boundaries of the different brands and organisational units, extending these already existing routines.

CEWE set up a dedicated campus for artificial intelligence and mobile technologies, the Mobile & Artificial Intelligence Campus (MAIC), to keep pace with technological developments. The portfolio moved towards software and mobile solutions (according to a company presentation from 08/2020: mobile, cloud, AI, smart data, and voice control). Figure 4 summarises the episodes.

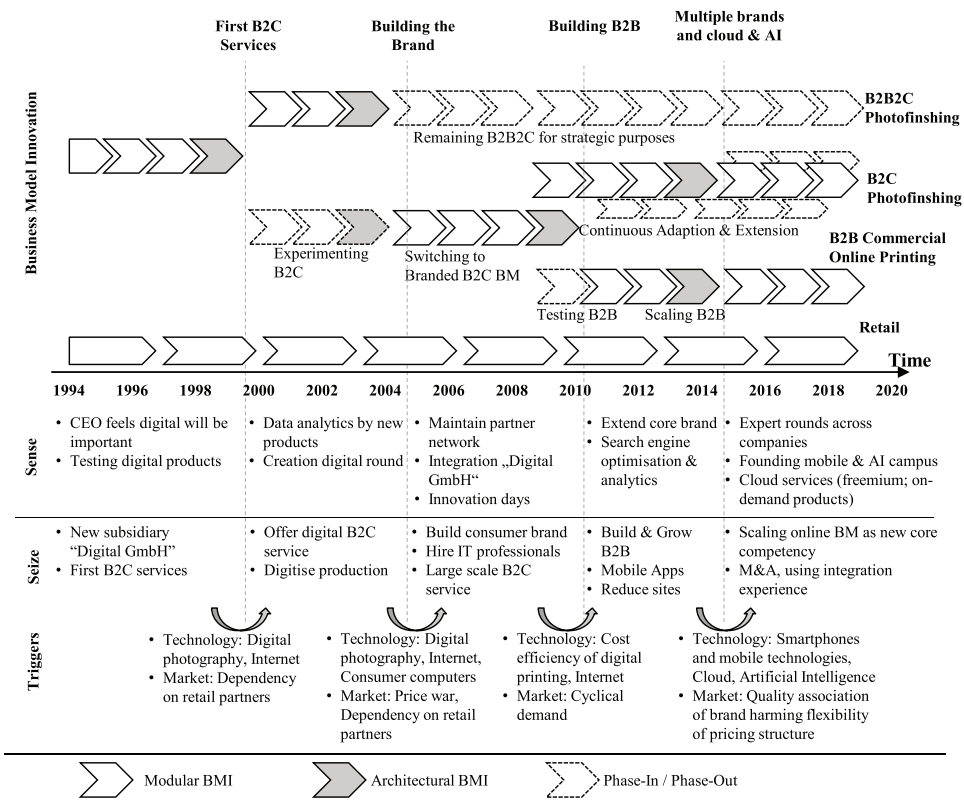


Fig. 4. The interplay of CEWE's business model innovation and dynamic capabilities.

A Process Model of Business Model Innovation and Dynamic Capabilities

Development, Utilisation, and Routinisation of Dynamic Capabilities by Business Model Innovation

In this chapter, we show how CEWE developed and utilised various dynamic capabilities. We observed different routines that developed over time to build and maintain dynamic capabilities, which proved helpful for CEWE's journey in continuously innovating its BMs.

First, **developing separate organisational units** can support introducing new BMs into an existing organisation (Blindenbach-Driessen and van den Ende, 2014; Bock *et al*., 2012). CEWE used its low-margin and low-revenue hardware business to understand new geographical markets and its customers as a foundation to develop the brand in priorly unknown regions: "*We wouldn't have known […] through which channel […] to offer our product*" (ID3). The hardware business, a unit largely independent from the core business, is used to understand the environment and the customers on a small scale and a specific niche, following ambidextrous goals (Kortmann, 2012; Lukoschek *et al*., 2018). Further, CEWE founded a digital subsidiary to test new, technology-based BMs and develop new competencies. Once the new BMs ran and grew, the separate unit was reintegrated and evolved into the core business. Integrating different organisational units can be challenging for organisations from information technology (Hasselbring, 2000; Ricciardi *et al*., 2018) and a cultural perspective, especially if a rather explorative team becomes part of exploitation. In our case, the dynamic capability of developing separate organisational units gives rise to BMI. The outcome of its utilisation for CEWE was the ability to focus BMI on dedicated customer needs to offer more customer-focused BMs, and to test services based on new technology (e.g., the internet in the 1990s) outside the core business.

Second, **fostering open communication and cultural change** evolved into a crucial dynamic capability to allow and give rise to BMI. To introduce new BMs, managers need to promote an appropriate organisational culture (Teece, 2017). CEWE relied heavily on different routines that evolved over time to build this capability. The organisation introduced different formats for open discussions on innovations, including various departments and hierarchies ("digital circle", later changed to "innovation circle", "innovation days", and "expert circle" across brands) that take place regularly, from weekly to yearly. These not only served as a fountain for new ideas, and thus gave rise to various BMI, but improved company-wide commitment towards the decision to perform a certain BMI, i.e., supporting it: "*But I would also say that the major guidelines in the company […] go […]*

also [through] these innovation circle" (ID 2). Further, tools supported a growing cultural change among employees: "*[…] If someone at the conference table said: 'Well, and what do we do now with the photobook?' Then he was immediately asked to pay two euros into the cash box right away because it's called a CEWE photobook*" (ID 1). These routines support cultural change and commitment and, in turn, support alignment, e.g., of BMs and brands (Logman, 2021), which CEWE had to ensure when turning away from the white label.

Third, **enabling and governing bottom-up leadership** supported various BMIs for CEWE. The know-how is developed in different units and sites, enabling a mix of top-down and bottom-up governance: "*we still also have very strong decentralised competencies and don't just wait for the headquarter*" (ID 2). Additionally, companies acquired by CEWE were not fully integrated, but rather routines such as expert circles allowed knowledge exchange and adoption of processes. In technology-driven enterprises, distributed competencies can support innovation (Granstrand *et al*., 1997). This bottom-up governance enables all employees to engage in innovative activities, fostering BMI on all levels. It translates to a strong identification: "*And what's nice is that the voice of the individual from the field also has an impact*" (ID 7). Indeed, distributing sensing and seizing through an organisation and all levels can be beneficial and realised by efficient communication and flat hierarchies (Reitzig and Maciejovsky, 2015; Teece *et al*., 2016). Still, strong leadership in the CEO role ("*And then, with our CEO, came the clear focus on brand strategy* […]" (ID 5) as well as in general in the management supported the various BMIs as well as a cultural change. Continuity in the management provided stability for the multiple changes—since 1961, CEWE has appointed only its fourth CEO. Strong leadership skills can translate into organisational identification and cultural change, supporting the transition to a new BM (Teece, 2018).

Fourth, bred by BMI, **building competencies internally** evolved to a crucial capability. CEWE initially lacked know-how in specific technologies and required external support for its first digital products, like the *PhotoIndex*, and the subsequent BMIs allowed by these, like an aftersales business by the *PhotoIndex*. Through these BMIs, CEWE realised they needed to build competencies internally: "*But we also quickly realised that we have to have these core competencies in-house, and we cannot outsource them. We have to develop them ourselves*" (ID 1). By hiring professionals with new skill sets, CEWE nourishes the development of know-how. Developing technological competencies in-house can benefit innovation outcomes (Huang, 2011). Still, collaboration with research can broaden an organisation's horison—to keep open, CEWE opens its own "mobile and AI campus". In our case, BMI fosters the development of competence-based capabilities internally. For CEWE, these capabilities resulted in the possibility to generate

data for and the ability to analyse consumer behaviour and further allowed to offer after-sales BMs.

Fifth, **fostering mutual partnerships** supported, in the case of CEWE, various BMI and simultaneously was further built by these BMIs. Despite switching to a brand and mainly B2C BM, CEWE wanted to keep its partners: "[…] *the retail partner must also win. If they lose, […] we will lose them as well*" (ID1). In CEWE's case, even though entirely switching to direct sales would have been possible, the partners themselves served as a source of innovation and fostered various BMI. At the same time, the partnerships were crucial in establishing the brand at the point of sales, and, by these learnings, the BMIs reinforced the utilisation of strong and mutual partnerships. Regular and dedicated partner meetings and events proved helpful.

Sixth, CEWE is **fully incorporating technological innovation** into its core competencies and core business. This capability was developed by various BMIs by learning how to integrate technology-based innovations iteratively in various steps, from testing the first digital products to founding own units and up to dedicating a whole AI campus to it. A digital subsidiary is founded, later incorporated, and responsible for an entirely new BM. Digital channels have become the primary means of communication, and digital services enhance CEWE's portfolio. By 2013, the BM itself had a dedicated own subsection in the annual reports. By 2020, CEWE speaks of "online BM" as a core competency (CEWE, 2020), having performed various BMIs that led to this competency. Speed in anticipation and adaptation of the BM by technology is vital: "*Especially in the current time, the speed of change or adaptation of the business model is absolutely necessary to stay in business*" (ID 5). This capability enhanced CEWE's ability to realise when a new product or service was necessary as consumer analysis was possible, allowed to create individualised products, open new sales channels, and offer entirely new BMs, such as cloud storage.

A process model of continuous business model innovation and dynamic capabilities

Building and utilising dynamic capabilities with modular business model innovation

From our case study, we observe different processes during the continuous innovation of the BMs. We first focus on single episodes, i.e., before an architectural BMI occurs to introduce a new BM. Two key processes occur within one episode: First, modular BMI builds dynamic capabilities. Triggers are technological developments (technology) and market developments (external). For example, the advent of digital photography and subsequent digital printing technology triggered small innovations in the first and second episodes, such as introducing a *Photo CD*

to digitise pictures or the *PhotoIndex* to increase the re-ordering of pictures. These innovations led to a slight adaptation or extension of CEWE's existing BM but did not architecturally change it. However, with these innovations, new dynamic capabilities are developed. In the case of CEWE, the capability to integrate technology is built and the capability to develop separate organisational units is used.

Second, the newly developed dynamic capabilities are utilised, supported by routines, within further modular BMI, e.g., when technological know-how can be leveraged to adapt the existing BM. For example, with the introduction of the *Photo Kiosk*, CEWE learned how to install and use a touchpoint at the PoS and how consumers interact with it. Out of these learnings, CEWE advanced to introduce the *PhotoMaker,* enabling new customer channels and new value propositions. These modular BMIs further increased the existing ones and built up new dynamic capabilities, for example, how to transmit, manage and use digital data within the production process. With the *PhotoIndex*, the capability of integrating digital technology was built and utilised in BMI by analysing consumer behaviour and offering a BM that taps the after-sales potential.

Dynamic capabilities enabling to perform architectural business model innovation

Another sub-process unfolds to offer a new BM, i.e., architectural BMI. Compared to the prior process, now a mix of different triggers and the availability of developed dynamic capabilities enable an architectural BMI. The outcome of this change, which is relatively more extensive compared to the modular innovations within one episode, is a new BM.

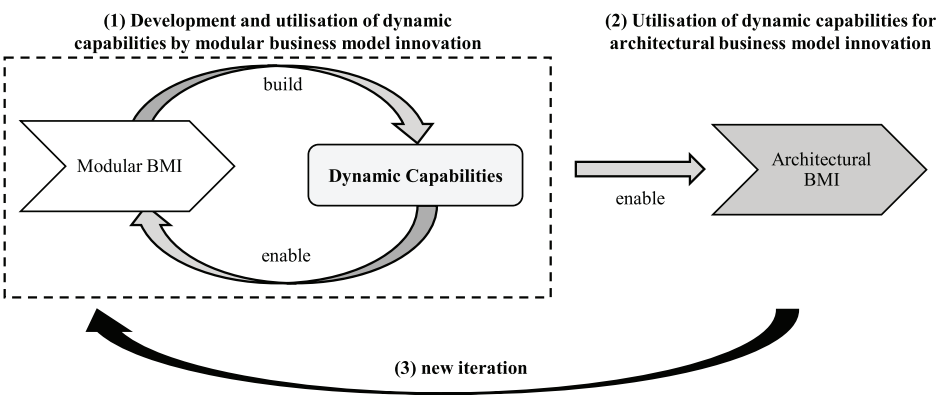
For example, during the second episode, CEWE introduced an entirely new B2C BM, offering a labelled, end-consumer product, performing the activity of an architectural BMI. Different triggers led to this activity: price pressure and bargain power with retailers (market), rising sales of digital cameras and increasing technological advancement of complementing products (technology), and the advent of the internet (technology). Further, CEWE developed different capabilities by the various modular BMIs performed priorly: CEWE realised new services are necessary with the rise of digital cameras and computers; tested internet-based services; realised individualised products' rise in popularity with consumers, and developed products to generate digital data and skills to analyse it to understand consumers' behaviour. The combination of these triggers and the possibility to utilise the developed dynamic capabilities enabled CEWE to perform the architectural BMI. The outcome was an entirely new BM, with a branded product being sold directly to consumers *via* own (internet-based) channels (B2C) as well as using the existing partner network (B2B2C).

A process model of continuous business model innovation and dynamic capabilities

A more significant process becomes imminent when considering CEWE's BMI over the whole analysis period, incorporating the priorly described sub-processes. Modular BMI adapts one or few components of an existing BM. These activities build new or enhance existing dynamic capabilities. Routines support this development. These dynamic capabilities are utilised within further modular BMI, leading to a cycle of building dynamic capabilities by modular BMI and utilising dynamic capabilities for further modular BMI. At some point in time, technology and market triggers come together with developed capabilities, allowing to perform an architectural BMI. The priorly developed dynamic capabilities are used to introduce a new BM.

For example, in the second episode, CEWE developed various capabilities regarding technology, understanding consumers, and analysing its environment. Combined with market and technology triggers, CEWE introduced a new BM, directly addressing consumers with digital sales channels and an entirely new and branded product, the *CEWE Photobook*.

The process model in Fig. 5 shows how modular BMIs build dynamic capabilities, which in turn enable further modular BMIs. Thus, modular BMIs build dynamic capabilities and utilise them simultaneously. At some point, the built dynamic capabilities enable to perform an architectural BM. A mix of external triggers and the developed dynamic capabilities lead to the decision to perform an architectural BMI. Once an architectural BMI is performed, a new iteration of developing and utilising dynamic capabilities by modular BMI starts.



(1) Modular BMI builds dynamic capabilities, which in turn enable further modular BMI, until an organisation has developed sufficient dynamic capabilities to (2) perform an architectural BMI. The organisation is equipped to change its entire BM(s), leveraging their capabilities. After accomplishing an architectural BMI, (3) a new iteration begins of building up dynamic capabilities before a new architectural BMI is possible

Fig. 5. A process model of continuous business model innovation and dynamic capabilities.

Discussion

Organisations need to keep up with the pace of technological development and changing environmental conditions. With BMI, organisations can leverage technology and achieve a competitive advantage. However, research is missing insights on how continuous BMI unfolds in detail as a series of activities and what role dynamic capabilities take in that process. Building on existing BM research and dynamic capabilities, we build on a longitudinal study to introduce a process model, elaborating on continuous BMI as a mixture of modular and architectural BMI activities. The model shows the role dynamic capabilities take within that process, being outcome and antecedent. Our model explains how BMs are continuously innovated by building and utilising dynamic capabilities with modular BMI and leveraging developed capabilities with architectural BMI. Further, we identify dynamic capabilities and show routines that enable practitioners to apply the model and continuously innovate their BMs.

Our model explains how dynamic capabilities are developed and leveraged and underpins the importance for organisations to foresee certain developments to leverage the potential of dynamic capabilities, a yet under-researched area (Fergnani, 2020). Further, the model shows how modular BMI can support developing dynamic capabilities. The usefulness of the dynamic capabilities framework within BMI was shown by prior literature, using it as a lens to study antecedents (Foss and Saebi, 2017; Teece, 2017). Randhawa *et al*. (2020) showed how dynamic capabilities are antecedent to continuous BMI. Our results support that view but further extend the understanding of dynamic capabilities simultaneously as antecedents and outcomes of continuous BMI. Further, the model and its constructs relate to other topics in BMI research. For example, Demil and Lecocq (2010) introduce the label of dynamic consistency in the evolution of BMs, which is an emergent and deliberate change of BMs. This capability elaborates on the balance between a BM's performance and the continuously changing environment influencing a BM. In addition to emergent change, our model drills down on conscious decisions and demonstrates how emergent change is translated to conscious decisions and how these decisions innovate BMs continuously. The environment is an external trigger, which is leveraged by dynamic capabilities.

Theoretical contributions are threefold. First, we contribute to the literature on dynamic capabilities. We provide explicit dynamic capabilities and show how these can be built, how they are utilised, and which outcomes can be achieved. Our results support how routines build and manifest capabilities, e.g., weekly innovation circles enabling a cultural change or play-like communication tools ("*pay two euros into the cash box*" (ID1)). Further, our case shows that building capabilities by learning across organisational boundaries is is possible. However,

for Cewe for CEWE, only to a certain extent, as integrating knowledge was central. With that, we answer calls from research for the development of dynamic capabilities to proceed through typical stages over time (Fischer *et al*., 2010; Schilke *et al*., 2018). Our model offers one possibility of how these capabilities are developed with BMI. Further, we show how dynamic capabilities are utilised by continuously engaging in BMI and, by that, explicitly show repeatable mechanisms for organisations (Schilke *et al*., 2018; Vial, 2019). For example, the capability of enabling and governing bottom-up leadership is utilised by a balance between stability in the CEO position and strong decentralised competencies, which are regularly aligned by formats such as innovation days. Contradictorily, we could not observe path-dependencies in the utilisation of capabilities. Regarding outcomes, we observed different outcomes when utilising dynamic capabilities. Some examples include a strong identification of employees with an organisation, the alignment of brands and business models, an increased speed to adapt, the possibility to offer after-sales BMs, and the ability to analyse customer behaviour to achieve competitive advantage by customer-focused business models. The capability of developing and utilising separate organisational units allows focusing BMI on more dedicated customer needs and results in more customer-centric business models.

Second, our results explain the relationship between continuous BMI and dynamic capabilities. We highlight the suitability of the dynamic capabilities framework to study continuous BMI and clarify how dynamic capabilities can be developed and utilised by BMI. The developed model shows dynamic capabilities are developed with modular BMI. We further show how dynamic capabilities are antecedent to BMI but simultaneously are the outcome of a continuous process. We show how firms can use modular BMI to build dynamic capabilities and utilise dynamic capabilities to enable architectural BMI. With that, we answer calls to study dynamic capabilities concerning BMI (Foss and Saebi, 2017; Schneider and Spieth, 2013; Teece, 2017). We enrich research on BMI and dynamic capabilities and demonstrate how both enable and build on each other.

Third, for research on BMI, we show how continuous BMI unfolds in detail over a long period. We explain how modular BMI develops dynamic capabilities and how these, in turn, enable architectural BMI. Further, the model shows how various modular BMIs occur before another architectural BMI is possible. Therefore, introducing a new BM or architecturally innovating an existing BM requires some stability for the organisation, and not too many new BMs should be offered within a short timeframe. With the model, we provide antecedents to BMI, but further show how dynamic capabilities can simultaneously be the outcome of BMI. Further, we demonstrate how different dynamic capabilities can support

continuous BMI to achieve a long-term competitive advantage. We follow calls to advance research on BMI and its drivers (Foss and Saebi, 2017, 2018).

For practice, our results guide organisations to navigate their BMI journey successfully. We show how organisations can leverage their capabilities in continuous BMI. Further, we show how capabilities can be developed in small steps, engaging in modular BMI. We identify dynamic capabilities that support firms to innovate their BMs and show routines to build and manifest these capabilities. Additionally, the narrative that extends through three decades will help organisations to better grasp the effects of time in their continuous innovation journey. The rich narrative gives insights into different aspects, such as M&A, brand building, or incorporating of digital technology, which supports practitioners to reflect on their situation.

This study has its limitations. This paper aims to analyse a longitudinal case in-depth over 27 years. The generalisability of single-case studies is partly constrained (Yin, 2018). Further, interviewees, in part, had to deliver retrospective accounts of events. We mitigated by additionally analysing company reports and archives to triangulate our insights. Additionally, our two-folded coding procedure involved a descriptive part in assessing BM components and an inductive part to understand why CEWE performed certain activities, how these activities unfolded, and to which outcomes these activities led. By nature, this coding is partly subjective. We mitigated these issues using the principles of constant comparison and iterative coding along with the triangulation of heterogeneous data sources. Regarding the derived model, we demonstrated the connections between our model and constructs used within the extant work (Bacharach, 1989). Still, different contextual conditions apply, which need to be demonstrated (Suddaby, 2010). The generalisability of a model derived from a single case study is limited by the nature of the research approach. Further, our model cannot elaborate on the cognitive decisions related to BM choices nor formal conceptualisations of BMs. Additionally, dynamic capabilities can be path-dependent. The dynamic capabilities present in our study focus on our case, and their generalisation within a model does not reflect this path-dependency, as we could not observe it.

Future research can use our results to study further the interdependence of continuous BMI and dynamic capabilities. Analysing firms that use several BMs in parallel will enable investigating spillovers and synergies between innovations of different BMs. Future research can also focus on the timing and timespan between BMI to develop and enhance dynamic capabilities. We expect there can be too much acceleration within the process of BMI, which could turn out harmful in the end and harm the balance of a BM, and requires further research. Studying additional cases can provide a suitable database to test and extend our model. Further, we used dynamic capabilities as a lens to study continuous BMI. Other theories

could be suitable as well and should be determined within future research, which, however, are not suitable for our research endeavour. Last, we follow an existing and widely accepted distinction between modular and architectural BMI. Future research should analyse the differentiation of modular and architectural BMI and what these types entail, building on empirical research strategies.

Conclusion

To remain competitive in dynamic markets characterised by fast-changing customer demands and a high pace of technological progress, firms need to adapt to their environment and stay ahead of the competition (El Sawy and Pereira, 2013; Tallon *et al*., 2019; Teece, 2017). Continuously innovating BMs is necessary to leverage technological progress and can be a successful survival approach in a demanding competitive environment, but it remains a complex challenge for firms (Foss and Saebi, 2017; Massa *et al*., 2017). Dynamic capabilities elaborate how firms ensure long-term success by continuously adapting to the environment and transforming. Yet, how continuous BMI unfolds and how dynamic capabilities support it remains understudied.

This study sheds light on these challenges. We derive a process model of continuous BMI based on a single, longitudinal, in-depth case study of CEWE, a European player in the photofinishing industry. CEWE has survived in a challenging industry by continuously leveraging technology and innovating its BMs and is now a multi-brand, market-leading organisation. Within the 27-year analysis period, we show how modular BMI leads to more significant architectural BMI and entirely new BMs. We derive a process model on continuous BMI. It explains how modular BMI builds dynamic capabilities and how architectural BMI utilises them. The model elaborates the role dynamic capabilities take in that process, both the outcome *and* the antecedent of BMI. It further displays how continuous BMI unfolds in detail. The dynamic capabilities presented show how practice can shape this process successfully and how technology becomes deeply integrated into BMI.

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Appendix A.1. Definitions of Core Constructs Used Throughout this Paper.

Table A.1. Core concepts used throughout this paper.

Dynamic Capabilities	Dynamic capabilities refer to a firm's ability to integrate, build, and reconfigure internal competencies to address changes in the business environment (Kump *et al*., 2018; Teece *et al*., 1997; Teece, 2007).
Business Model	An articulation of how a business creates, delivers, and captures value (Osterwalder and Pigneur, 2010; Teece, 2017).
Business Model Innovation	"Designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017).
Modular Business Model Innovation	Innovating one or few components of a BM, i.e., evolutionary and focused BMI (Foss and Saebi, 2017).
Architectural Business Model Innovation	Changes in the overall business model by innovating several BM components simultaneously, i.e., adaptive and complex BMI (Foss and Saebi, 2017).
Continuous Business Model Innovation	An ongoing process constituted of various activities to innovate one or several components of a BM repetitively over time.

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Appendix F. Requirements and Design Principles for Business Model Tools (P6)

Aug 10th, 12:00 AM

Requirements and Design Principles for Business Model Tools

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Requirements and Design Principles for Business Model Tools

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Abstract

Software tools hold great promise to support the modeling, analyzing, and innovation of business models. Yet, both research and practice lack a clear overview of the requirements and design principles for developing such tools. To tackle this issue, we gather requirements and design principles for business model software tools based on a structured literature review. We cluster the requirements within five core functions of tools and map subsequent design principles. By collecting and synthesizing various requirements and design principles, we provide a foundation for further research on business model software tools. In practice, these results contribute to the development of tools and can serve as an evaluation framework for intermediate development states and existing business model software tools. Future research can employ these results for artifact creation. This research guides the development of business model software tools to support firms in sustaining a competitive advantage.

Keywords

Business Model, Requirements, Tool, Analysis, Simulation

Introduction

Business Models (BMs) are important for company success, and they receive significant attention in theory and practice (Al-Debei and Avison 2010; Ebel et al. 2016; Szopinski et al. 2019; Weking et al. 2019). With competition growing steadily due to digitalization and globalization, and environments and customer requirements changing faster than ever, companies are forced to continuously adjust their BMs if they want to stay competitive (Augenstein 2019; Ebel et al. 2016; Saebi 2015). A BM describes the methods of value creation, value delivery, and value capture of a business venture (Teece 2010).

A BM needs to be developed, analyzed, and benchmarked against competitors. In practice, it is important to analyze and optimize the model for profitability and robustness, while allowing for strategic flexibility. The complexity of modeling and innovating a BM increases in today's business environment, and alternative BM decisions need to be evaluated (Athanasopoulo et al. 2018b). With external shocks, fast-changing legislation, and intensifying competition, it is necessary to frequently adapt or innovate a BM (Augenstein et al. 2018; Schaffer et al. 2019; Weking et al. 2018).

To develop, evaluate, and manage BMs, computer-aided tools can be of help (Osterwalder and Pigneur 2013; Szopinski et al. 2019). The literature emphasizes the potential benefits software tools can offer and has called for further research on the subject (Ebel et al. 2016; Szopinski et al. 2019; Veit et al. 2014). Osterwalder and Pigneur highlight that tools "[…] should go beyond simple design tools and evolve into an own class of high-level decision support tools" (Osterwalder and Pigneur 2013). It is necessary to understand the requirements for the development of tools, and to know which design principles can be applied to fulfill these requirements. Researchers and practitioners lack guidance on building and selecting software tools (Szopinski et al. 2019). Extant BM research focuses on a variety of aspects and is fragmented

(Massa et al. 2017). To the best of our knowledge, no comprehensive and integrative review of requirements and design principles for developing BM software tools exists.

To support the development of such tools, this paper gathers requirements and design principles for BM software tools based on a literature review. We use this methodology to structure the fragmented literature on BM software tools to provide an organized and integrative view supporting tool development.

The remainder of the paper is structured as follows: First, we illustrate the literature on extant software tools for BMs. Afterward, we outline the applied methodology of our research, building on a literature review following the guidelines of Webster and Watson (2002). Subsequently, the concrete requirements and design principles are introduced, clustered along five core functions identified within the coding process. In concluding the paper, we present the implications of this research.

Extant Software Tools for Business Models

The basis for tools in the context of BMs is a defined understanding of what constitutes a BM, i.e., which BM ontology or representation is applied. The most common model is the Business Model Canvas by Osterwalder and Pigneur (2010), which has become the quasi-standard for representing BMs (Massa et al. 2017). The Business Model Canvas is a BM ontology and, at the same time, the literature presents it as a tool for BM innovation. Other widely known tools are the e3-Value ontology (Akkermans and Gordijn 2003) or the St.Gallen Business Model Navigator (Gassmann et al. 2013).

Within this review, we focus on the requirements and design principles for BM software tools. Software tools are created using modern IT resources, such as software applications. Various software tools have been proposed to allow the representation and change of BMs (Szopinski et al. 2019). Many of the existing tools are restricted to designing and visualizing a BM (Terrenghi et al. 2017). Individual attempts have been made to identify IT's role in other areas, such as BM transformation, evaluation, and management (Augenstein 2019; Rambow-Hoeschele et al. 2019; Terrenghi et al. 2017). Dellermann et al. (2019) develop a decision support system for BM validation. Peinel et al. (2010) describe a modeling method to support BM planning in the context of eGovernment. In a series of papers, Athanasopoulo et al. develop a tool for BM development in the context of the Internet of Things, implementing prefilled BMs utilizing so-called solution-based patterns (Athanasopoulo et al. 2018a; Athanasopoulo et al. 2018b; Athanasopoulou and de Reuver 2018).

Regarding the requirements for BM software tools, Szopinski et al. (2019) analyzed 24 programs in practice, providing characteristic functions and a comprehensive taxonomy of those tools. Dellermann et al. (2019) developed design principles for decision support systems for BM validation. Ebel et al. (2016) proposed 20 functions to innovate BMs. Fritscher and Pigneur (2014b) analyzed user adoption of key features of computer-aided BM design. Yet, existing software tools are often not used to their full potential and mostly support a rather static perspective on BMs, not allowing to evaluate different strategic scenarios or to incorporate inherent dynamics.

Methodology

We gathered requirements and design principles based on a structured literature review following the guidelines proposed by Webster and Watson (2002). To avoid bias resulting from exclusively searching articles in specific domains or leading journals, we used three different databases: Scopus, EbscoHost and Google Scholar.

All search streams included the term "business model" as this is the focus of our research. We focused on two additional terms ("tool" and "requirements") along with synonyms of these terms, connected with an AND-operator. We did not restrict the search to the term "tool", as the term itself is used in different ways within the literature. We additionally searched for "software", "IT support", "decision support", "evaluat*", "simulat*" (as there are evaluation and simulation approaches in the BM context, which also use tools, that are not tagged as such) and "simulation". Along with "require*", we searched for "design principle" and "function*". We used a variety of search streams combining the terms above within the databases. The most important search queries were:

- ("business model" AND (tool OR software OR "IT support" OR "decision support" OR evaluat* or simulat*))
- ("business model" AND (require* OR "design principle" OR function*))

The literature search led to a total of 1147 hits within the databases. After extracting doublets, the initial number of papers found was 627. We first screened article abstracts and then read the full texts. In our review, we included articles that 1) deal with BMs and 2) describe either software-based tools (or similar, as mentioned above) or provide requirements or design principles. For the final selection, we included only double-blind reviewed articles to ensure the use of high-quality literature and articles that have BM tooling as the central research topic. After a forward/backward search, the final sample consisted of 17 papers.

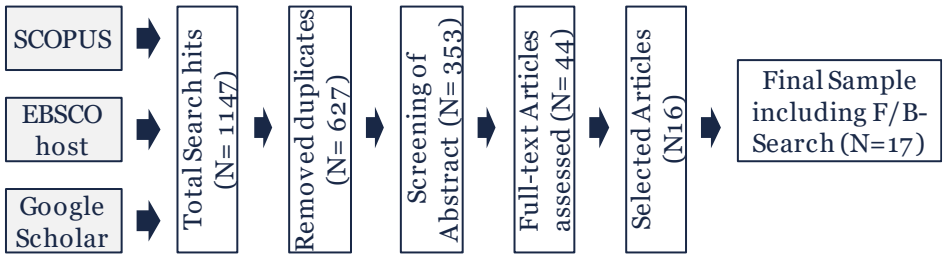

Figure 1: Literature search process

For the coding process, two authors independently screened the articles and afterward read the full texts to derive requirements. Inconsistencies in decisions were resolved through discussion and mutual agreement. We follow definitions by Glinz (2007) for requirements. We clustered the requirements among core functions and mapped subsequent design principles. The core functions were derived from the literature search and coding process and display the main categories of functions that BM software tools typically possess. These functions are largely based on the taxonomy of functions for BM development tools in Szopinski et al. (2019) and are the following: *Modeling Support, BM Design, BM Analysis and Evaluation, Collaboration,* and *Technical Requirements*.

Requirements and Design Principles

Based on the coding process presented previously, we derived requirements and subsequent design principles in our five core functions. The requirements present specific demands upon tools stated in the literature. The design principles propose concrete solutions on how a specific requirement can be implemented. Some authors postulate requirements without elaborating on design principles and vice versa.

Modeling Support

Modeling Support contains the requirements and subsequent design principles for the guidance of users when they engage with the tool. These are, to a large extent, not related to the BM itself, such as providing a stimulating interface, motivating users, or offering clear descriptions. Next, BM-specific requirements to provide support during modeling and to ensure quality are provided. For example, these include the guidance through different BM development phases, automated guideline validations by automated flags, and ensuring the completeness of a BM with a syntax checker. The complete requirements of this function are presented in Table 1.

Requirements	Design Principles
Provide a stimulating interface (Athanasopoulo et al. 2018a; Ebel et al. 2016)	Multimedia content (Ebel et al. 2016)
	Simple, user-friendly interface (Athanasopoulo et al. 2018a; Fritscher and Pigneur 2014a)
Users have to be motivated (Ebel et al. 2016; Zec et al. 2014)	Gamification techniques (Zec et al. 2014)
The user should be assisted in being creative (Szopinski et al. 2019)	BM patterns (Szopinski et al. 2019)
	Random or semi-automatically selected idea stimuli (Szopinski et al. 2019)

The tool should be adaptive to the abilities of the users (Athanasopoulo et al. 2018a)	n.a
Provide an incentive which justifies the need for providing additional information (Fritscher and Pigneur 2014b)	n.a
Raise users' perception of the system's capabilities and provide a clear description of the purpose of the BM tool (Athanasopoulo et al. 2018a; Ebel et al. 2016)	Explanatory information (Ebel et al. 2016)
Guide users across all phases of the BM development process (Ebel et al. 2016; Fritscher and Pigneur 2014b; Schoormann et al. 2018b; Voigt et al. 2013; Zec et al. 2014)	Shared material: Repository of training material (Ebel et al. 2016)
	Phase management (Szopinski et al. 2019)
	Wizards (Fritscher and Pigneur 2014b; Voigt et al. 2013)
Enforce or suggest good practice beyond implementing its underlying model (Fritscher and Pigneur 2014b)	Feature promotion (best practice) (Fritscher and Pigneur 2014b)
	Entry constraints (use of keywords) (Fritscher and Pigneur 2014b)
The tool should facilitate the handling of a BM (Fritscher and Pigneur 2014b; Szopinski et al. 2019)	Link to BMs and framework support (Szopinski et al. 2019)
	Element clipboard (Szopinski et al. 2019)
	Model comparison (Szopinski et al. 2019)
	Element filter (Fritscher and Pigneur 2014b; Szopinski et al. 2019)
Guarantee the coherence of the underlying meta-model by implementing automated guideline validations (Fritscher and Pigneur 2014b; Zec et al. 2014)	Validation attributes (Fritscher and Pigneur 2014b)
	Automated visual flags (Fritscher and Pigneur 2014a)
	Automated hints (Fritscher and Pigneur 2014a; Zec et al. 2014)
	Coherence score (Fritscher and Pigneur 2014a)
	Assessment status (Szopinski et al. 2019)
Ensure correct, complete BMs and usage of provided features (Fritscher and Pigneur 2014b; Rambow-Hoeschele et al. 2019; Szopinski et al. 2019; Voigt et al. 2013)	Syntax checker (Szopinski et al. 2019; Voigt et al. 2013)
	Error warnings (Rambow-Hoeschele et al. 2019)
The BM representation should have a clear structure (Athanasopoulo et al. 2018a; Haaker et al. 2017)	Graphical separation of areas in the BM (Voigt et al. 2013)
Allow users to track the success of their actions (Ebel et al. 2016)	Feedback mechanism (Ebel et al. 2016)
Provide for constant grounding in the modeling process (Voigt et al. 2013)	Representation of the profitability of the BM (Voigt et al. 2013)
Give the user the possibility to correct mistakes (Voigt et al. 2013)	Undo/Redo buttons (Voigt et al. 2013)
Use of a common language and terminology to enable natural interaction (Fritscher and Pigneur 2014a, 2014b; Szopinski et al. 2019; Voigt et al. 2013)	Symbolic language familiar to user (e.g. icons) (Voigt et al. 2013)
	Standardized controls (Voigt et al. 2013)
	Glossary support (Szopinski et al. 2019)

Table 1. Requirements and Design Principles for Modeling Support

Business Model Design

BM Design consists of the requirements for designing a concrete BM. This function focuses explicitly on the process of designing a BM with a tool and the design principles relevant to that process. These are for example a section managing different models, the creation and editing of components, as well as the promotion of common terminology during design. One highly relevant requirement for the tool-based design of BMs is the provision of templates with predefined attributes, elements, BM types, interrelations, or even entire pre-made BMs. Providing templates increases the ease of use and is highly relevant in providing user support during design. Especially for users without a profound knowledge of BMs, the use of templates is crucial and enhances their ability to understand. Additionally, templates help ease the adoption of software-based tools, as they increase usability and reduce the time needed for the design process. Table 2 shows the aggregated list of requirements and design principles for *Business Model Design*.

Requirements	Design Principles
Users have to be able to customize the underlying BM to best fit a certain context (Giessmann et al. 2013; Szopinski et al. 2019)	Adding of components (Schoormann et al. 2018a, 2018b; Szopinski et al. 2019)
	Mering and dividing of components (Schoormann et al. 2018a, 2018b; Szopinski et al. 2019)
	Renaming of components (Schoormann et al. 2018a, 2018b; Szopinski et al. 2019)
	Changing the arrangement of components (Schoormann et al. 2018a, 2018b; Szopinski et al. 2019)
	Linking of components (Schoormann et al. 2018b; Szopinski et al. 2019)
	Coloring of components (Schoormann et al. 2018a)
	Creation of BM types (Giessmann et al. 2013)
Provide functionalities for a detailed description of the underlying BM (Di Valentin et al. 2015; Fritscher and Pigneur 2014a, 2014b; Giessmann et al. 2013; Szopinski et al. 2019; Terrenghi et al. 2017)	(Re)naming and description of created BMs (Giessmann et al. 2013)
	Adding of elements (Fritscher and Pigneur 2014a; Schoormann et al. 2018b; Szopinski et al. 2019; Voigt et al. 2013)
	Deleting of elements (Fritscher and Pigneur 2014a; Schoormann et al. 2018b; Szopinski et al. 2019; Voigt et al. 2013)
	(Re)naming elements by using text fields (Fritscher and Pigneur 2014a; Schoormann et al. 2018b; Szopinski et al. 2019; Voigt et al. 2013)
Allow users to create their own semantic meaning (Fritscher and Pigneur 2014b)	Duplicating of elements (Fritscher and Pigneur 2014a; Szopinski et al. 2019)
	Free (re)positioning of elements (Fritscher and Pigneur 2014a, 2014b; Schoormann et al. 2018b; Szopinski et al. 2019; Voigt et al. 2013; Zec et al. 2014)
	Guided (re)positioning of elements (Fritscher and Pigneur 2014b)
	Enable the application of BM templates (Athanasopoulo et al. 2018a; Di Valentin et al. 2015; Ebel et al. 2016; Fritscher and Pigneur 2014b; Giessmann et al. 2013; Schoormann et al. 2018b; Szopinski et al. 2019)
	Enable the creation and customization of templates (Fritscher and Pigneur 2014b; Giessmann et al. 2013)
Enable logical grouping of elements (Fritscher and Pigneur 2014b)	Coloring of elements (Fritscher and Pigneur 2014a, 2014b; Zec et al. 2014)
	Links by drag and drop (Fritscher and Pigneur 2014b)
Provide features for specifying BM versions/variants to compare different solution options (Ebel et al. 2016; Fritscher and Pigneur 2014a; Schoormann et al. 2018b; Voigt et al. 2013)	Hiding/showing elements selectively (Fritscher and Pigneur 2014b) (Fritscher and Pigneur 2014a)
	Collaborative editor according to the wiki principle (Ebel et al. 2016)
Users have to be able to refine the BM (Giessmann et al. 2013)	Feedback loop (Di Valentin et al. 2015; Giessmann et al. 2013)

Table 2. Requirements and Design Principles for Business Model Design

Business Model Analysis and Evaluation

There are a variety of possibilities for the analysis and evaluation of BMs. The main requirements proposed are the analysis of the external environment, financial analysis, evaluating a BM's robustness, the identification and planning of changes within a BM, and the visualization and analysis of interdependencies between BM elements. For example, for financial evaluations, different design principles, such as "what-if" analysis, benchmarking, and price simulations can be applied to fulfill these requirements. In general, for the analysis of BMs, the requirements mostly propose metrics-based approaches and call for simulations. Based on this, concrete and quantitative scenarios can be derived and simulated according to the varying goals of the analysis.

In his doctoral thesis, Augenstein (2019) provides a series of papers addressing tooling within the context of BMs, from which requirements for the integration and annotation of data for analysis are derived. The author develops a tool for mining data for the modeling and analysis of BMs based on a mining algorithm. The requirements and subsequent design principles for *Business Model Analysis and Evaluation* are summarized in Table 3.

Requirements	Design Principles
Users need to be able to conduct an analysis of the company's competitive environment and add data to the data set to create a shared understanding (Giessmann et al. 2013; Terrenghi et al. 2017)	Industry benchmarks and market analyses (Ebel et al. 2016)
	External links (Ebel et al. 2016)
	Attachments of external documents (Ebel et al. 2016)
	Shared write board (Ebel et al. 2016)
	Data extraction and import (Giessmann et al. 2013)
Provide calculation and consolidation functions to aggregate only BM relevant source data, as well as merging logics to recombine the data (Augenstein 2019)	Structured data tables of raw data (Augenstein 2019)
	Mining algorithm (Augenstein 2019)
Provide functionalities to keep track of external developments (Ebel et al. 2016)	Push notifications (Fritscher and Pigneur 2014a, 2014b)
Need for a prompt signal that can spot a disruption or threat, or opportunity, in advance (Terrenghi et al. 2017)	
Enable to digitally visualize interdependencies between BM elements to make value creation process and interdependencies explicit (Augenstein 2019; Szopinski et al. 2019)	Databases in the background (Rambow-Hoeschele et al. 2019)
	Semantic network (Augenstein 2019)
	Visual links (Augenstein 2019)
	Internal links (Rambow-Hoeschele et al. 2019)
Users need to be able to identify potential changes to their BM (Athanasopoulo et al. 2018a)	The existing BM should always be visible (Athanasopoulo et al. 2018a)
Help to plan the transition from a current to a future BM (Szopinski et al. 2019)	BM roadmapping (Szopinski et al. 2019)
Provide functionalities that allow for basic BM evaluations (Schoormann et al. 2018b; Szopinski et al. 2019)	Non-financial assessment (e.g. ratings or likes) (Szopinski et al. 2019)
	Trade-off analysis (Schoormann et al. 2018a)
	Creation & evaluation of alterantive BMs (Athanasopoulo et al. 2018b)
Provide a basic predetermined profit calculation (Fritscher and Pigneur 2014b)	Predefined attributes on cost structure and revenue (Fritscher and Pigneur 2014a)
Generate different financial estimation scenarios for the BM (Di Valentin et al. 2015; Szopinski et al. 2019; Terrenghi et al. 2017)	BM simulation (Terrenghi et al. 2017; Voigt et al. 2013)
Provide functions for simulating and financially evaluating a BM (Szopinski et al. 2019; Voigt et al. 2013)	Quantitative information such as prices, costs and quantities (Szopinski et al. 2019)
	Financial analysis module (Voigt et al. 2013)
	Competition anaylsis (Giessmann et al. 2013)
	Direct benchmark (Giessmann et al. 2013)
	Attribute variation analysis (Giessmann et al. 2013)
	Price simulation (Giessmann et al. 2013)
	"What-if" analysis (Zec et al. 2014)
Visualize the robustness of BM components in a certain scenario or future development by providing BM stress testing (Haaker et al. 2017; Szopinski et al. 2019)	Heatmap (Haaker et al. 2017)
Provide a crowd-based classifier to predict the outcomes of BM design choices based on human assessment (Dellermann et al. 2019)	Development and training of a machine learning algorithm (Dellermann et al. 2019)
	Classification and Regression Tree (CART) (Dellermann et al. 2019)
After running analyses and simulations, final refinement and adaptation of attributes should be possible (Giessmann et al. 2013)	Selection of favored variant (Giessmann et al. 2013)

Table 3: Requirements and Design Principles for Business Model Analysis and Evaluation

Collaboration

Software tools can use different functionalites to enable collaboration among users. Collaboration mainly aims to streamline workflows among teams and improve communication, speeding up progress, and increasing the satisfaction of users. In the BM context, collaboration requirements vary, including offering ways for users to interact with each other, real-time collaboration (for example, by real-time collaborative

modeling), and allowing and automating reciprocal feedback processes. However, it is important to note that, even though collaboration functions offer various benefits, they are by no means essential for software-based BMs and tend to increase the technical complexity of development. Table 4 provides different requirements and design principles for *Collaboration*.

Requirements	Design Principles
Facilitate collaboration across time, location and organizational boundaries (Ebel et al. 2016; Schoormann et al. 2018b; Zec et al. 2014)	Software as web application (Zec et al. 2014)
	Software as virtual platform (Ebel et al. 2016)
Provide user and role management functions to support the coordination of the collaborative work on a BM (Szopinski et al. 2019)	User management (Szopinski et al. 2019)
	Role management (Szopinski et al. 2019)
	Task sharing (assignment of tasks) (Szopinski et al. 2019)
Community: Enable interaction between users (Dellermann et al. 2019; Ebel et al. 2016; Schoormann et al. 2018a, 2018b; Szopinski et al. 2019; Voigt et al. 2013; Zec et al. 2014)	Creation of profile pages (Ebel et al. 2016; Schoormann et al. 2018b)
	Message functionality for synchronous communication (Ebel et al. 2016; Schoormann et al. 2018a, 2018b; Szopinski et al. 2019; Zec et al. 2014)
	User lists with search and tagging functionality (Dellermann et al. 2019; Ebel et al. 2016; Szopinski et al. 2019; Voigt et al. 2013)
	Discussion board for asynchronous communication (Szopinski et al. 2019)
Provide features for (real-time) collaborative development and refinement of the BM (Dellermann et al. 2019; Ebel et al. 2016; Schoormann et al. 2018a, 2018b; Szopinski et al. 2019; Voigt et al. 2013; Zec et al. 2014)	Locking features (Voigt et al. 2013)
	Multi-format comments (Dellermann et al. 2019; Ebel et al. 2016; Szopinski et al. 2019; Voigt et al. 2013)
	Sharing of BM projects (Schoormann et al. 2018a, 2018b; Voigt et al. 2013; Zec et al. 2014)
	Copying of BMs (Schoormann et al. 2018b; Voigt et al. 2013)
	Multi-format export of BM projects (Schoormann et al. 2018a, 2018b; Voigt et al. 2013; Zec et al. 2014)
Enforce a separation of single and team phases to increase the quantities of idea (Zec et al. 2014)	Single phase: Hidden contributions (Zec et al. 2014)
	Group phase: Visible contributions (Zec et al. 2014)
Support the reduction of social anxiety or evaluation apprehension (Zec et al. 2014)	Allow for anonymous contributions of users (Zec et al. 2014)
Allow for quick selection of the best models within the group (Dellermann et al. 2019; Voigt et al. 2013)	Model rating (e.g. star voting, multi-criteria Likert scales) (Dellermann et al. 2019; Voigt et al. 2013)
Provide users with different types of working on a BM (Szopinski et al. 2019)	Asynchronous modeling (Ebel et al. 2016)
	Concurrent modeling (Ebel et al. 2016)
	Collaborative synchronous modeling (Szopinski et al. 2019; Zec et al. 2014)
Allow users to track changes made in the BM (Schoormann et al. 2018b; Zec et al. 2014)	Snapshots (Zec et al. 2014)
	Reasoning features (Schoormann et al. 2018a, 2018b)

Table 4. Requirements and Design Principles for Collaboration

Technical Requirements

Besides user support and mostly non-functional requirements, there are a variety of functional requirements proposed, summarized within the core category of *Technical Requirements*. These requirements describe which standards can or should be supported, what kind of export and import functions should be available, if and how integration with other tools should happen, what kind of attachments and reports are necessary and propose different technical architectures. Table 5 provides the identified technical requirements and design principles.

Requirements	Design Principles
Provide machine feedback capability to predict the outcomes of BM design choices based on statistical assessment (Dellermann et al. 2019)	Classification and regression tree (CART) (Dellermann et al. 2019)
	"Labelling" of milestones to train machine learning algorithm (Dellermann et al. 2019)

	Calculation of the success probability by applying a learning algorithm for analyzing interactions between BM components (Dellermann et al. 2019)
Provide a knowledge aggregation repository to allow it to learn from the process (Dellermann et al. 2019)	Storage in JSON format (Dellermann et al. 2019)
Provide visual guidance representation so that the user can continuously monitor the BM and obtains access to informative and suggestive guidance (Athanasopoulo et al. 2018a; Augenstein 2019; Dellermann et al. 2019; Terrenghi et al. 2017)	Visualization with dashboard & real-time monitoring (Dellermann et al. 2019; Terrenghi et al. 2017)
	Detailed information including KPI sections (Augenstein 2019)
	Prioritization for list of identified changes (Athanasopoulo et al. 2018a)
Alerts must notify BM owners if crucial parameters deflect (Terrenghi et al. 2017)	Capturing of parameters (Terrenghi et al. 2017)
Export functionality of financial calculations are required for business casing (Voigt et al. 2013)	Export of financial data in MS Excel (Voigt et al. 2013)
Provide a translation of the interface into different languages (Fritscher and Pigneur 2014b)	n.a.
Enable the integration with other classes of tools (Szopinski et al. 2019; Terrenghi et al. 2017; Voigt et al. 2013)	Provide data format compatability (Voigt et al. 2013)
Provide one or more types of applications regarding the architecture of the tool (Szopinski et al. 2019)	Client/server (Szopinski et al. 2019)
	Web-based (Szopinski et al. 2019)
Provide a model management section, where each user can access all BMs s/he has permission on (Szopinski et al. 2019)	Overview list (Voigt et al. 2013)
	Sort functionality (Voigt et al. 2013)
	Search functionality (Voigt et al. 2013)
	Tags (Voigt et al. 2013)
	Editing of BMs (Voigt et al. 2013)
	Access to modeling environment (Voigt et al. 2013)
	Import of BMs (Szopinski et al. 2019; Voigt et al. 2013)
The collected information needs to be structured and needs a filtering process (Schoormann et al. 2018a)	Idea management tool (Schoormann et al. 2018a)
To enable bottom-up creation of a BM, appropriate data needs to be identified and accessed by establishing a repository of relevant BM data sources and allowing extraction of BM-relevant and reliable source data from it (Augenstein 2019)	One unified BM ontology (Augenstein 2019)
	Flow and relations (Augenstein 2019)
	Support of diverse data sources (ERP, Excel, Paper etc.) (Augenstein 2019; Terrenghi et al. 2017)
	Double-check of data (Augenstein 2019)
Support at least one or more different unified BM frameworks/ontology-based representations (Augenstein 2019; Dellermann et al. 2019; Ebel et al. 2016; Fritscher and Pigneur 2014b; Haaker et al. 2017; Schoormann et al. 2018a, 2018b)	Selection of different system-holistic BM languages (Schoormann et al. 2018a, 2018b)
	Adding and designing of additional approaches (Schoormann et al. 2018b)
Provide an ecosystem view (Terrenghi et al. 2017)	n.a.
A tool should be as non-constraining and flexible as possible (Ebel et al. 2016; Fritscher and Pigneur 2014b; Terrenghi et al. 2017; Zec et al. 2014)	Allow for additional data in various formats (Ebel et al. 2016; Fritscher and Pigneur 2014b; Szopinski et al. 2019; Zec et al. 2014)

Table 5. Technical Requirements and Design Principles

Discussion and Conclusion

Software tools hold great promise to support the modeling, analyzing, and innovation of BMs. Yet, both research and practice lack a clear overview of the requirements and design principles for developing such tools. This paper gathers requirements and design principles for BM software tools with a literature review. A variety of requirements have been identified and clustered in five core functions. First, regarding modeling aspects, the tool needs a motivating interface that can be adapted to the user according to their background and skills. The tool should guide through different modeling phases with an engaging structure and perform automated checks on modeling standards. Furthermore, it should promote ideas and stimulate creativity by suggesting BM patterns. Second, for BM design, the tool needs to be able to create, alter, and manage different BM designs. It should also provide users with templates for BM types, attributes, components, and even offer complete BMs. Third, for analyzing and evaluating BMs, the tool should provide

different approaches for financial analysis tests. It should be able to visualize possible BM changes and incorporate environmental changes into modeling. Fourth, a BM design tool should offer collaborative features. For example, users should be able to communicate synchronously and asynchronously within their community. It should be possible to model and design a BM simultaneously with several users. Fifth, there are technical requirements and design principles that BM tools should meet. These cover basic demands, such as interoperability with other tools, export and import functions, reporting, and specific technical architectures for incorporating operational data. Concrete design principles are mapped onto these requirements that support implementing these requirements in a software tool.

Our results are based on a review of the existing literature and have certain limitations. To mitigate subjective coding, we used collaborative input from two researchers. As the requirements were aggregated from different literature sources, we cannot ensure that the provided list of requirements and design principles is exhaustive, nor that the assignment of requirements onto the core functions is fully consistent. The resulting overview of requirements is generic. To use these results for tool development, contextualization has to occur, for example, according to industry specifics.

This study has several implications for research and practice. For researchers, we collect, combine, and synthesize various requirements and design principles for BM software tools. In this way, we provide an overview of the current literature and a foundation for research on BM tooling. For practitioners, the collection of requirements and design principles establishes a starting point for the agile development of new BM software tools. Furthermore, it can serve as an evaluation framework for intermediate development states and existing BM tools.

We identify three key areas for future research. First, researchers can build on our review, using it to identify the first two steps of a design science approach for developing a BM tool, that is (1) identifying the problem and motivation and (2) defining objectives for a solution (Peffers et al. 2007). Second, empirical research can validate our findings. Third, future research can evaluate the usefulness of BM software tools. We show that the BM and its innovation are crucial for sustainable firm success. We provide guidance regarding requirements and design principles for developing innovative BM tools that can support firms in sustaining a competitive advantage.

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Appendix G. A Tool to Model and Simulate Dynamic Business Models (P7)

A Tool to Model and Simulate Dynamic Business Models

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Abstract Software tools hold great promise to support the modeling, analyzing, and innovation of business models. Current tools only focus on the design of business models and do not incorporate the complexity of existing interdependencies between business model components. These tools merely allow simulating inherent dynamics within the models or different strategic decision scenarios. In this research, we use design science research to develop a prototype that is capable of modeling and simulating dynamic business models. We use system dynamics as a simulation approach and containers to allow deployment as web applications. This paper represents the first of three design cycles, realizing six out of 59 requirements that are collected from the literature on software tools for business models. We contribute toward the design of novel artifacts for business model innovation as well as their evaluation. Future research can use these results to build tools that consider and address the complexity of business models. Lastly, we present several options for extending the proposed tool in the future.

Keywords: dynamic business model, tool, simulation, design science, system dynamics.

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1 Introduction

Companies need to develop innovative offerings to remain competitive (Amit and Zott, 2010). Business model innovation (BMI) has manifested itself as an important concept for theory and practice (Haaker et al., 2017; Marolt et al., 2018), and managers, in particular, should pay more attention to it (Pang et al., 2019). The impact of BMI has been regarded as superior to technological innovation (Chesbrough, 2007; Still et al., 2017; Teece, 2010). Thus, research on the methods and tools to implement BMI has become an important aspect in managing innovation (Amit and Zott, 2010; Becker et al., 2017; Schneider and Spieth, 2013; Teece, 2010).

With the abundance of data and computing power, software tools can perform the required modeling and analysis of business models (BMs) for innovation (Osterwalder and Pigneur, 2013; Szopinski et al., 2019). Numerous contributions have called for further advancement of the topic (Ebel et al., 2016; Szopinski et al., 2019; Veit et al., 2014) and even suggest to explore "…the application of computer-aided design tools to design tasks such as prototyping, simulating, iterating and versioning business models…" (Osterwalder and Pigneur, 2013). At the same time, the complexity to model and analyze BMs is rising. Particularly, the optimization of a BM for profit, growth, innovation, and robustness, while ensuring dynamic adaptation and strategic flexibility, are core use cases for managers (Cosenz and Noto, 2018).

However, most concepts, frameworks, and tools for BMs and BMI presented in the literature are inflexible and therefore limited in their use cases. For example, they allow for analyzing and representing the current state of a company's BM but fail to account for dynamic behavior or future states of a particular BM (Augenstein et al., 2018; Schaffer et al., 2019). Managers can be assisted in evaluating available alternatives of BMI and supported in ongoing decision making, through software-based artifacts, by performing simulations on a diverse set of strategic scenarios and BM configurations (Schaffer et al., 2019).

Therefore, the goal of this paper is to present a prototype of a tool that is capable of modeling and simulating inherent dynamics in BMs. With this study, we contribute to research on BM tooling and provide practitioners with a first version of an applicable artifact based on the completion of the first iteration within a design science research (DSR) cycle (Peffers et al., 2007).

2 Background and Related Work

2.1 Business Models and Dynamics

In prior research, numerous concepts and frameworks for developing and innovating BMs have been proposed (Arreola González et al., 2019; Marolt et al., 2016). According to Massa et al. (2017) BMs can be understood, among other interpretations, as formal conceptual representations of how an organization operates. As such, these concepts and frameworks describe the value creation, value delivery, and value capture logic of a venture (Teece, 2010). The Business Model Canvas, as a conceptual representation, has become the quasi-standard for representing BMs (Massa et al., 2017). Further, a variety of other frameworks are available. In our study, we utilize the business model component framework by Krumeich et al. (2012), which uses a component-based description similar to the Business Model Canvas, yet allowing to describe a BM in more detail, as it consists of 20 components.

With external upsets, rapid changes in legislation, and increasing competition, a BM and its underlying factors are subject to ongoing adaptation. This has led to the perspective of dynamic BMs, which can be defined as "…a complex system of interrelated sub-components of the value creation, delivery and capture mechanisms, which is interacting with heterogeneous internal and external influences leading to the evolution of its components and the system itself." (Schaffer et al., 2019). Compared to a static approach, a dynamic perspective recognizes BMs as correlated and complex systems of various elements. Furthermore, a BM is not only changed purposefully, but it is also exposed to inherent dynamics that occur unintentionally. The analysis of induced changes in a business model is crucial (Groesser and Jovy, 2016). In such complex systems, decision-makers require support to quickly take informed and effective decisions (Jere Jakulin et al., 2020).

One technique to model these dynamics is through simulation. By developing causal loop diagrams, the logical interdependencies in a complex and dynamic BM can be captured (Casadesus-Masanell and Ricart, 2010) and simulation models can be derived. A literature-based review of existing interdependencies between BM components can be found in Schaffer, Drieschner et al. (forthcoming). In the context of BMs, a suitable simulation approach is system dynamics (SD) (Cosenz and Noto, 2018). SD is a computer-aided approach to enhance analysis and decision making in complex systems (Moellers et al., 2019), and according to Täuscher and Chafac (2016) "SD focuses on identifying nonlinear causal relations in a system". As such, it accounts for nonlinearities, delayed cause-and-effect, and feedback relationships (Groesser and Jovy, 2016). However, building effective simulation models is a complex task and requires a deep understanding of simulation approaches. In practice, simulations can be used to evaluate different BM choices (scenarios) toward, for example, the adaptability, profitability, or robustness of a BM. However, to encourage practical implementation, the ease of use needs to be increased, since the typical consumer of the simulation outcomes is middle management, innovation managers, entrepreneurs, and potential investors. These consumers are typically only interested in the simulation results, and often hesitate to apply resources to model BMs required for simulation.

2.2 Extant Software-Based Tools for Business Models

To account for the complexity of BMs, managers use software-based tools to aid the process of modeling and innovating BMs. One well-known example is the e3-Value ontology (Akkermans and Gordijn, 2003). Other examples include Dellermann et al. (2019) who developed a decision support system for BM validation and Peinel et al. (2010) who described a modeling method to support the planning of BMs in the context of eGovernment work. Groesser and Jovy (2016) provide a quantitative approach for BM analysis, based on a SD-simulation, to address dynamic complexity in BMs and interactions of company initiatives, BMs, and their elements. Techniques have been proposed to identify the role of information technology (IT) in other areas, such as BM transformation, evaluation, and management (Augenstein, 2019; Rambow-Hoeschele et al., 2019; Terrenghi et al., 2017). In a series of papers, Athanasopoulo et al. provided a tool for BM development in the context of the Internet-of-Things, implementing prefilled BM templates and utilizing so-called solution-based patterns (Athanasopoulo, de Reuver, Haaker, 2018; Athanasopoulo,

de Reuver, Kosman et al., 2018; Athanasopoulou and de Reuver, 2018). However, the majority of the existing software-based tools are restricted to visualizing and designing a BM and do not offer simulation capabilities (Terrenghi et al., 2017). To our knowledge, no tools exist that offer the capability to simulate different BM design choices (i.e., scenarios), or that depict existing interdependencies between components to account for inherent dynamics.

3 Methodology

By definition, the result of applying DSR is "a purposeful IT artifact created to address an important organizational problem" (Hevner et al., 2004). An artifact may be a decision support system, a modeling tool, a governance strategy, an IS evaluation method, or an IS change intervention (Gregor and Hevner, 2013). Since the goal of this research is to create a tool that enables decision support, we adhere to the DSR guidelines for developing such an innovative artifact to an unsolved problem as proposed by Hevner et al. (2004) and Gregor and Hevner (2013). Table provides an overview of our DSR approach according to the process defined by Peffers et al. (2007). This approach entails creating an understanding of the context and the perceived problem, design a solution, interpret, and test the prototype with a real-world use case. Through this process we are aligning with prior DSR approaches on BM tooling, such as Athanasopoulo, Haaker et al. (2018).

Table1: DSR approach applied within this research, adapted from Peffers et al. (2007)

Step	Activities
(1) Identify Problem & Motivation	Identify the problem and highlight importance (Section 1 and 2)
(2) Define Solution Objectives	Select six requirements and derive concrete design principles (Section 4.1)
(3) Design & Develop	Implement the tool to develop and simulate dynamic BMs (Section 4.2)
(4) Demonstration	Apply the artifact to a case study (Section 5)
(5) Evaluation	Evaluate a problem-solution fit and determine requirements and improvements for the next design iteration (Section 6)
(6) Communication	Publish problem and proposed solution to receive feedback from academia

The first step of our DSR cycle is the problem identification and the motivation of the topic as in the first two sections of this paper. Second, we define the objectives and the requirements of our proposed software tool used for BM development and simulation. The third step, following the requirements and design principles, is to

design and implement the artifact for decision support. Finally, we demonstrate the artifact using a case study on a digital platform ecosystem for the German tourism industry. In our case, the platform owner uses the tool prototype to assess alternative options for the configuration of the value proposition in a first iteration. This iteration comprises the alpha and beta testing and an initial use case to show that the proposed tool can be used to solve practical problems (Hevner et al., 2004). We evaluate the artifact and derive conclusions regarding its functionality in the fifth step listed in Table 1 (Verschuren and Hartog, 2005). According to Prat et al. (2014), the instantiation and the demonstration of the use of an artifact is a valid evaluation. Particularly, we discuss preliminary results of the artifact and options for improvement in subsequent iterations. Finally, we conclude our first iteration by providing our insights to the community and by making the artifact available for further contributions from the scientific community (Hevner et al., 2004).

4 Artifact Description: Tool Prototype

In this DSR project, we focus on the design of a prototype that is functional for further evaluation, based on the requirements that we identified from the literature. In our first cycle, we created a working prototype of a software-based tool, which can model and simulate BMs and their components. In this section, we present the requirements and applied design principles, followed by the tool prototype.

4.1 Requirements and Design Principles

To define the objectives of the proposed solution, we obtained requirements and design principles for BM tooling based on existing literature (Peffers et al., 2007). We build on our prior work, during which we identified 59 requirements and subsequent design principles for BM tools based on a comprehensive literature review (Schaffer, Weking et al., forthcoming). These are 1) requirements regarding dynamic BMs and 2) general requirements toward BM tooling and decision support systems. Since this prototype represents the first design cycles of the overall research setting, we selected the most relevant requirements to create the first artifact, ensuring the relevance and practicality of the presented artifact. Within the first research cycle, we selected six out of 59 identified requirements (see Schaffer, Weking et al., forthcoming), which are listed in Table 2. Three researchers involved in designing the BM of the use case depicted in Section 5 were asked to prioritize

the requirements in a way that reflected their immediate needs. Based on this prioritization, we selected the requirements in Table 2, as they describe the core functionalities necessary for a running prototype and were prioritized by potential users.

Table 2: Requirements identified and selected for the tool prototype in the first iteration

Requirement 1: Build on existing BM representations and use a clear structure (Athanasopoulo, de Reuver, Kosman et al., 2018; Augenstein, 2019; Dellermann et al., 2019; Haaker et al., 2017; Schoormann et al., 2018)
Requirement 2: Users have to be able to customize the underlying BM to best fit a certain context (Giessmann et al., 2013; Szopinski et al., 2019)
Requirement 3: Provide features for specifying BM versions/variants to compare different solution options (Ebel et al., 2016; Schoormann et al., 2018; Voigt et al., 2013)
Requirement 4: Enable modeling of interdependencies between BM elements (Augenstein, 2019; Schaffer et al., 2019; Szopinski et al., 2019)
Requirement 5: Provide functions for simulating and financially evaluating a BM (Szopinski et al., 2019; Voigt et al., 2013)
Requirement 6: Facilitate collaboration across time, location, and organizational boundaries with the architecture of the tool (Dellermann et al., 2019; Ebel et al., 2016; Schoormann et al., 2018; Zec et al., 2014)

For the artifact specification, we selected subsequent design principles for the respective requirements. These also stem from prior work (Schaffer, Weking et al., forthcoming). Our goal was to specify a useable artifact, with design principles that can be easily comprehended and at the same time fulfill the requirements. The following design principles, as presented in Table 3, are used for implementation.

Table 3: Design principles employed to fulfill identified requirements for the tool prototype

Req.	Design principle	Description
R1	Use of existing framework by Krumeich et al. (2012)	Providing a clear structure by using an existing framework consisting of 20 components
R2	Individual creation, editing, and linking of components (Giessmann et al., 2013; Schoormann et al., 2018; Szopinski et al., 2019)	Allow customization by various editing and adjustment functionalities
R3	Creating different models and versions of them (Voigt et al., 2013)	Model management section to create and compare various models and versions of them
R4	Modeling of interdependencies between components and effects on existing interdependencies (Augenstein, 2019; Szopinski et al., 2019)	Function to create visual links as well as to create dependencies within the underlying functions used for simulation
R5	Definition of quantitative information within elements and interdependencies used for simulation (Szopinski et al., 2019; Voigt et al., 2013)	For each element, specific parameters, and mathematical functions can be defined and used by the simulation
R6	Containerized software as a web application (Zec et al., 2014)	The architecture as web application allows collaboration without regional or time boundaries

4.2 Tool prototype

The prototype of our tool is depicted in Figure. The bar on the left presents the hierarchical logic of our tool. After logging in, users can create a new project, for example, based on their use case, represented in the "projects" view. Within a project, a variety of BMs can be generated and simulated. The "models" section in the center of Figure is the modeling environment. This environment is based on SD (Forrester, 2009). To translate the concepts of SD into BMs, we used stocks from SD as BM components, while flows from SD were used to describe interrelations between the components. Stocks in SD describe entities that can accumulate or be depleted, such as resources. Flows are entities that lead to an increase or decrease in a stock, for example an adoption rate influencing the total number of customers. As such, one stock represents a maximum of one BM component; however, more than one stock can be used to model a component, e.g. different types of resources within the component resource model.

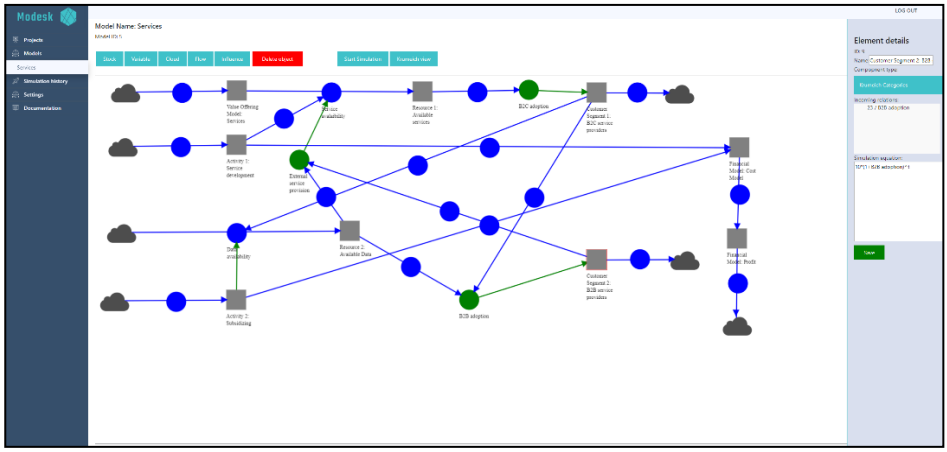

Figure 1: Tool prototype. Left: Navigation bar. Middle: Modeling environment depicting a case from a research project (see Section 5 of this research). Right: Editing section

Components can be grouped for better comprehension. We use the *Business Model Component Framework* of Krumeich et al. (2012) to describe each of the components, as it is a detailed framework consisting of 20 components, allowing us to capture the complexity of a BM and prepare it for simulation. In Figure 1, on the right, the editing section of an individual element is shown. Each element in the modeling environment can be described (element type, e.g., BM component; metrics, and equations for simulations) and edited individually. In the model depicted in Figure 1, the editing of the BM component Customer and Market Segment is shown. Users can choose the relevant BM component currently modeled from a dropdown list (turquoise button on the right), describe and edit the component, and define its metrics. The same is possible for additional variables and stimuli to create comprehensive models that are suitable for simulation. Once a model is created, users can run simulations directly in the modeling environment. If equations or metrics are missing, error warnings are shown for the respective components. Depending on the variables that have been defined, it is for example possible to simulate cash-flows for different scenarios. The simulations can be performed directly within the "models" section and be saved in the "simulation history" screen.

The prototype is designed as a containerized application, to allow easy deployment in different environments. To address the presented requirements and develop the prototype, we implemented the following technology stack:

- Docker for Containerization,
- Spring Boot, Angular, and Bootstrap for the application,
- MySQL for the database,
- Swagger for the API, and
- The simulation engine is self-developed and implemented in Java, following the rules of SD (Forrester, 2009).

5 Artifact Demonstration: Use Case of a Research Project Conceptualizing a Digital Platform Ecosystem

The use case to demonstrate our tool and its subsequent evaluation is a research project that aims to conceptualize a digital platform ecosystem for the German tourism industry. One relevant use case of the platform is connecting two customer segments: Business-to-business (B2B) service providers (component Customer Segment 2 in the modeling environment in Figure 1) and business-to-consumer (B2C) service providers (Customer Segment 1). Different key values are offered for both customer segments to get them on board (Engert et al., 2019). To provide value-added services, B2B service providers require a large amount of data to be exchanged through the platform. The B2C service providers are interested in the available services on the platform, which they can use and offer to their respective customers.

The success of this platform BM depends on the willingness of the B2C service providers to share their data within the ecosystem. If they provide sufficient data, B2B service providers are more eager to provide value-added services. The B2B service providers, on the other hand, are willing to create a service in exchange for data, as data monetization has become an important strategic option for many firms (Baecker et al., 2020). The platform BM has two options available:

- **Option 1:** Increase the BM component *Product and Service Offering* by increasing the number of available services (Resource 1) by, for example, creating services for the platform by the operator;
- **Option 2:** Increase the BM component *Resource Model* by increasing the amount of available data (Resource 2) on the platform by, for example, the operator paying B2C service providers to share their data.

Choosing either one of these options will have significant implications on the respective adoption rates, and thus on the growth of the platform and its BM. The complexity of the decision lies in the tradeoff between multiple future scenarios regarding the platform ecosystem. The proposed tool is capable of simulating this early stage, helping to evaluate the available options and resource investment decisions. In Option 1, creating own services, increasing the *Product and Service Offering* requires additional resources (Ressource 1), additional activities (Activity 1), and increased costs (Financial Model: Cost Model). Option 2, paying for the provision of data, requires additional activities (Activity 2), increased costs (Financial Model: Cost Model), and influences the customer relationship, the value proposition, and the profit (Financial Model: Profit). In Figure 1, only the relevant components of this setting are shown. Based on this model as depicted in Figure 1 and described above, both scenarios can be simulated.

The tool models these interdependencies and helps to understand occurring dynamics. Based on a set of assumptions and real-world data, it can be shown that Option 1, even though having higher initial cost (Financial Model: Cost Model), increases the overall adoption of the BM (the adoption rates of both customer segments increase stronger in this option than with Option 2) as well as the long-term profitability (Financial Model: Profit). Option 2 is more costly (Financial Model: Cost Model), and the costs increase even more with an increasing adoption rate by the B2C service providers (B2C adoption), while the adoption rate of B2B service providers is weaker.

6 Discussion and Conclusion

In this paper, we designed and evaluated a software tool to model BMs and their inherent dynamics. The proposed artifact is novel since existing tools hardly support the modeling of interdependencies between BM components and do not simulate dynamics or evaluate varied design choices.

Through our artifact, we contribute to research on BM tooling and dynamic BMs. For the two BM scenarios within the demonstrated use case, we successfully show the practical application of the tool and its' simulation functionality. We, therefore, contribute to the body of knowledge by showing that simulations and software tools, for complex BM decisions in practical settings, enhance decision support (Massa et al., 2017) in the context of BMI (Augenstein, 2019; Cosenz and Noto, 2018). Furthermore, we enhance literature on BM tooling by providing a tool allowing to evaluate different BM design choices and depicting interdependencies between components, thus accounting for dynamics (Osterwalder and Pigneur, 2013; Szopinski et al., 2019). At the same time, the tool is a step towards purposeful user-involvement in BM design and BMI.

This research is subject to certain limitations. Only a limited number of requirements have been realized, as we focused on the fundamental functionalities of our tool. The creation of simulation models is still complicated, not entirely accomplishing the goal of reducing the effort to conduct complex simulations. Furthermore, the evaluation of the tool prototype is demonstrated through the use of the artifact within a research project, with the BM being in a conceptual stage. Even though this is a valid evaluation method (Prat et al., 2014), additional iterations and more user feedback are required. For simulation, the tool uses SD-models, which are incomplete and can be extended and further validated (Täuscher & Chafac, 2016).

Based on this prototype and feedback received, we will expand the tool through case studies on the BMs of companies while continuing to evaluate the existing tool. The tool will be advanced by a new user interface and providing templates of generic patterns, building blocks, and where practical, entire models. More BM representations, such as the Business Model Canvas, will be implemented to allow selection of the desired framework by users. Further, we plan to implement a recommender system for modeling, which will reduce the complexity of modeling

and simulation. Automatic identification and notification of users of crucial dependencies between components is another option for advancing the proposed artifact. User involvement in BMI will be encouraged with a collaborative editor. In the tool's current form, for different scenarios, a model needs to be cloned and adjusted. However, for the updated design, we plan to implement the development and the evaluation of different scenarios within one model. Finally, a repository of models that have been developed with our tool could be provided anonymously and used as best practice guidelines for various practitioners.

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