ABSTRACT

The concept of business models has increasingly attracted interest in research and practice during the last decades. Businesses undergo continuous digital transformation that is driven by innovations like Internet of Things (IoT), Artificial Intelligence (AI) or Cloud Computing, which have an impact on the disruption of their business models. A business model describes how a company creates value and how this value is delivered to customers. It specifies how this value can be captured in form of revenues, compared to the expenses for the processes of value creation. For companies in the highly agile software industry, a thorough understanding and analysis of these factors is a key to their success.

Particularly for large software firms, the continuous development of innovations – which is manifested in the underlying solution portfolio offering – represents a difficult task. Large software companies rather tend to optimize and streamline their highly complex processes, structures and rules for the continued success of the current business model, product portfolio and customer segments. Approaches and technologies of BI, business activity monitoring and process mining already support a multi-faced analysis of key performance indicators. Decisions for the design of business models need to be made under the consideration of operative data from the core development processes in order to evaluate the impact of a company's core processes on the achievement of its strategic goals. However, this still requires a highly complex processing and validation of data. There exist a various number of reporting-related BI and analysis approaches, but how are the complex interactions within the entire solution portfolio and the impacts on strategic decisions? This complexity increases through data silos and unstructured business processes that are often a reason for the redundant development of data foundations in terms of decision support and management systems that support strategic decisions. Furthermore, to date dynamic business model approaches have a focus on strategic financial data such as revenues, profit and costs, not taking into account information about the product quality or the actual usage of the software by customers, which makes it difficult to consider the progress on innovations in the business model.

By applying a design science research method, the thesis addresses these shortcomings with the design of a conceptual approach that semantically links the value-creating processes in the software industry, such as processes of software development and distribution, as well as service-oriented processes, to the elements of software business models. The assignment of process KPIs and their thresholds to semantic process artifacts allows to estimate the impact of critical processes to the linked business model elements. Therefore, the main components of business models in the software industry are derived, broken-down into single artifacts and represented with their semantic relationships among each other. The semantic linking of business model components among each other and to process artifacts is based on a fundamental evaluation of the basic literature on generic and software-specific business models. Process standards like ITIL have been applied for the semantic representation of process artifacts.

Academia and practice benefit from new use cases through the semantic description and linking of business model components and business processes as well as the contribution to existing research results in the domains of business model analysis and business process management with a focus on the software industry based on the formalization of business model and process-related knowledge.

"The economic value of a technology remains latent until it is commercialized in some way via a business model. The same technology commercialized in two different ways will yield two different returns."[1]

HENRY W. CHESBROUGH

"The same products, services or technologies can fail or succeed depending on the business model you choose. Exploring the possibilities is critical to finding a successful business model."

ALEXANDER OSTERWALDER

1 INTRODUCTION

1.1 MOTIVATION AND RESEARCH CONTEXT

Business models are a central success factor for businesses today.[2] Driven by digitalization in almost every industry and the associated increasing competition, companies are forced to continuously rethink and renew their business models.[3] During the growing transformation from traditional to electronic business in the mid-1990s, the term *business model* emerged as a buzzword in both business and scientific publications.[4] When the dot-com bubble burst in the late 90s, scientists began to investigate the reasons why some enterprises could establish themselves successfully in the market while others had failed.[5] Hence, the business model as scientific unit represents a rather young research field.[6] To remain competitive, companies not only need to aim at innovating their products, services and processes, but also at stimulating and improving their business models, which makes the economic and practical importance of business models notable.[7] Particularly fast-evolving industries like the software industry constantly offer new opportunities for business model innovation,[8] as software can be

[1] CHESBROUGH (2010) *Business Model Innovation: Opportunities and Barriers*, p. 354.
[2] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*; OSTERWALDER, PIGNEUR AND TUCCI (2005) *Clarifying Business Models: Origins, Present, and Future of the Concept*, pp. 1-25; TIMMERS (1998) *Business Models for electronic Markets*, pp. 3-8; MAGRETTA (2002) *Why Business Models matter*.
[3] Cf. ROBINSON (2019) *Gartner - Magic Quadrant for Field Service Management*, pp. 1-2.
[4] Cf. MAGRETTA (2002) *Why Business Models matter*; BADEN-FULLER AND MORGAN (2010) *Business Models as Models*, pp. 156-171; BURKHART ET AL. (2011) *Analyzing the Business Model Concept: A comprehensive Classification of Literature*.
[5] Cf. BADEN-FULLER AND MORGAN (2010) *Business Models as Models*; AMIT AND ZOTT (2001) *Value Creation in E-Business*, pp. 493-520; MCGRATH (2010) *Business Models: A discovery-driven Approach*, pp. 247-261.
[6] Cf. MAGRETTA (2002) *Why Business Models matter*; TIMMERS (1998) *Business Models for electronic Markets*; LINDER AND CANTRELL (2000) *Changing Business Models: Surveying the Landscape*.
[7] Cf. COZZOLINO, VERONA AND ROTHAERMEL (2018) *Unpacking the Disruption Process: New Technology, Business Models, and Incumbent Adaptation*, pp. 1166-1202.
[8] Cf. DASILVA (2018) *Understanding Business Model Innovation from a Practitioner Perspective*, pp. 19-24; KLOSTERBERG (2010) *Die Bewertung von Softwareunternehmen*, pp. 255-273; SCHIEF (2014) *Business Models in the Software Industry: The Impact on Firm and M&A Performance*.

easily replicated and distributed, which makes it easy for new players to enter the market.[9] Thus, for companies in the software industry it is crucial to react dynamically to changing business environments with the adaptation of business processes and business models.[10]

Although several definitions for the concept of business models exist,[11] there is still a lack of theoretical consensus with regards to a generally accepted definition.[12] OSTERWALDER, PIGNEUR AND TUCCI define a business model as *"[…] a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm"*,[13] whereas, according to AMIT AND ZOTT, *"a business model depicts the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities*."[14]

Business models represent an interdisciplinary research field that emerged from the Information Systems (IS) and Strategic Management disciplines.[15] Regarding the distinction between the concepts of *strategy* and *business models*, researchers predominantly hold the position that both concepts are linked to but distinct from each other,[16] a point of view that is also applied in this thesis. Figure 1.1 shows the business model in its intermediary role between strategy and business processes.

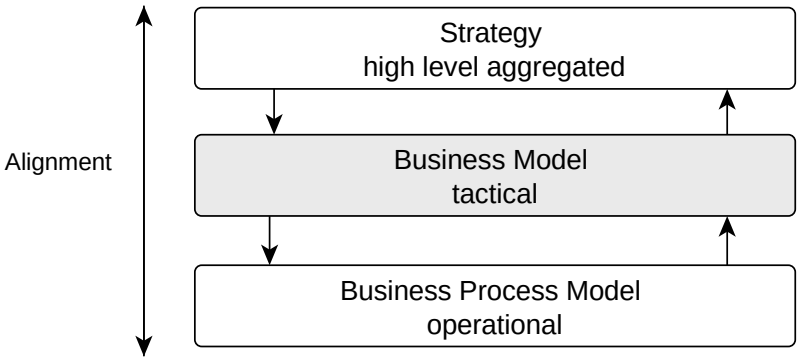

Figure 1.1 The business model as mediator between strategy and business processes[17]

Business models are primarily described as a mediator between strategy and business processes.[18] Strategy focuses on long-term goals like the positioning of a company in the market in order to

[9] Cf. BUXMANN, DIEFENBACH AND HESS (2015) *The Software Industry. Economic Principles, Strategies, Perspectives*, p. 3.
[10] Cf. KÄKÖLÄ (2003) *Software Business Models and Contexts for Software Innovation: Key Areas for Software Business Research*, pp. 1-8.
[11] Cf. AL-DEBEI AND AVISON (2011) *Developing a unified Framework of the Business Model Concept*, p. 362; PATELI AND GIAGLIS (2004) *A Research Framework for analysing E-Business Models*, pp. 305-306.
[12] Cf. RITTER AND LETTL (2018) *The wider Implications of Business-Model Research*, pp. 1-4; BURKHART ET AL. (2011) *Analyzing the Business Model Concept: A comprehensive Classification of Literature*, p. 2.
[13] OSTERWALDER, PIGNEUR AND TUCCI (2005) *Clarifying Business Models: Origins, Present, and Future of the Concept*, p. 3.
[14] AMIT AND ZOTT (2001) *Value Creation in E-Business*, p. 511.
[15] Cf. SCHIEF (2014) *Business Models in the Software Industry: The Impact on Firm and M&A Performance*, p. 2.
[16] Cf. SEDDON, LEWIS AND SHANKS (2004) *The Case for viewing Business Models as Abstractions of Strategy*, pp. 427-442.
[17] Adapted from AL-DEBEI, EL-HADDADEH AND AVISON (2008) *Defining the Business Model in the new World of digital Business*, p. 5.
[18] Cf. AL-DEBEI, EL-HADDADEH AND AVISON (2008) *Defining the Business Model in the new World of digital Business*, p. 5 ; PETROVIC, KITTL AND TEKSTEN (2001) *Developing Business Models for E-Business*, pp. 1-2.

differentiate it from competitors.[19] Business models describe *how a firm creates value* by offering a blueprint for the implementation of a given strategy. Therefore, business models offer a toolbox that depicts the relationships of a company to external players like customers, suppliers and markets, whereas business processes describe how these relationships are realized on an operational level.[20]

Several literature reviews revealed increasing evidence that the investigation of business models is a useful unit of analysis.[21] Particularly for companies in the digital economy, this represents a crucial factor, as the global software market is characterized by a high level of dynamics and heterogeneity,[22] which forces software companies to continuously rethink and renew their business models.[23] In 2018, worldwide enterprise software revenues achieved a total of $405 bn. US and for 2019 the by far highest growth, 8.3 percent, is expected.[24] Developments in cloud computing, collaborative and content applications and Software-as-a-Service (SaaS) reinforce an estimated growth of the global On-Demand market of more than 17.5 percent for 2019.[25] These developments demonstrate that software companies need to dynamically find new ways to add value to their delivered software solutions and to drive innovation, which comes along with the need for diversification, i.e. in the form of customized software solutions or service-oriented products.[26] This market has been opened up with the introduction of new business models ranging from web-based to free software models, activities with lower costs for production and delivery as well as lower market entrance barriers.[27]

A breakthrough of how a company implements core business activities often comes along with a disruption of the underlying business model.[28] Changing customer preferences, new regulations and potential partners as well as new emerging technologies force companies to continuously adapt their business models to these dynamics. One way to overcome this challenge is to monitor and analyze business processes, e.g. changing SLAs, etc. in operations and to adjust business models accordingly. Particularly the software industry offers manifold possibilities for the monitoring and analysis of business activities or software usage behavior (e.g. interactions or submitted customer requests, complaints, etc.).

Research to date mainly focuses on static aspects about business models like components or taxonomies, not taking into consideration the surrounding dynamics of the business context such as

[19] Cf. ZOTT AND AMIT (2008) *The Fit between Product Market Strategy and Business Model: Implications for Firm Performance*, p. 3-4.
[20] Cf. OSTERWALDER, PIGNEUR AND TUCCI (2005) *Clarifying Business Models: Origins, Present, and Future of the Concept*, pp. 7-8.
[21] Cf. LAMBERT AND DAVIDSON (2012) *Applications of the Business Model in Studies of Enterprise Success, Innovation and Classification: An Analysis of empirical Research from 1996 to 2010*; ZOTT, AMIT AND MASSA (2011) *The Business Model: Recent Developments and future Research*, pp. 1019-1042.
[22] Cf. FOIS AND LYSONICK (2012) *Analyzing the global Software Industry: Trends, Challenges and Evolution in the Business Model*, pp. 1-8.
[23] Cf. CHESBROUGH (2010) *Business Model Innovation: Opportunities and Barriers*, pp. 354-363; MCGRATH (2010) *Business Models: A discovery-driven Approach*, pp. 247-248.
[24] Cf. GARTNER (2018) *Gartner says global IT spending to grow 3.2 percent in 2019.*
[25] Cf. GARTNER (2018) *Gartner forecasts worldwide Public Cloud Revenue to grow 17.5 percent in 2019.*
[26] Cf. FOIS AND LYSONICK (2012) *Analyzing the global Software Industry: Trends, Challenges and Evolution in the Business Model,* pp. 1-8.
[27] Ibid.
[28] Cf. MCGRATH (2010) *Business Models: A discovery-driven Approach*, pp. 248-250.

operational information from business activities or current market data from competitors.[29] PORTER's Five Forces represent an example of the consideration of dynamic aspects and the competitor perspective in the context of corporate strategy.[30]

Scholars have not paid much attention to the dynamic relationships between business models and business processes.[31] Related attempts toward linking operational information with strategic concepts are either part of static layer models or they merely consider activities of performance measurement, not linking information from process executions to the key components of an underlying business model. The result is that decisions about changes to the current business model are often made too late, when the current business is already struggling.[32]

A consideration of dynamic aspects in the form of a recommender system would help decision-makers to compare their *as-is* business model with the *to-be* business model, and thus support the identification of business model-related aspects that should be adapted. The consideration of dynamic aspects in business models requires the consideration of the following research domains:

Layer-based approaches IS researchers have proposed some approaches that take into consideration operative information from process executions on the strategic layer.[33] Some researchers consider existing dynamics by linking changes made on the strategy layer with the organizational and IT/application layer.[34] These approaches are closely related to the Enterprise Architecture domain.

Process Performance Measurement There exist several approaches for the evaluation of operational information from process executions. Most models, such as Capability Maturity Model Integration (CMMI), consist of several layers. To each layer, several key measures are assigned.[35] However, the focus is on the software product and the quality of the software development process.

Research Gap 1 Multi-layer approaches are still predominantly static and do not explicitly consider business models. Performance measurement approaches do not consider a precise mapping of the activities on the process layer with the corresponding components of a business model. To date, management receives key measures from business processes through tools like Balanced Scorecard or process monitoring systems. However, the reason, *why* these values are achieved is often not considered. Furthermore, none of these approaches takes into consideration the characteristics of the software industry.

A comprehensive realization of the relationships between business models and business processes in the form of a recommender system requires an adequate formal and machine-readable representation

[29] Cf. MARKIDES (2006) *Disruptive Innovation: In Need of better Theory*, pp. 19-25; TEECE (2010) *Business Models, Business Strategy and Innovation*, pp. 172-194; VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, p. 56.
[30] Cf. PORTER (1985) *Competitive Advantage*, pp. 5-7.
[31] Cf. AHOKANGAS AND MYLLYKOSKI (2014) *The Practice of creating and transforming a Business Model*, pp. 6-18.
[32] Cf. DASILVA (2018) *Understanding Business Model Innovation from a Practitioner Perspective*, pp. 19-21; CHESBROUGH (2007) *Business Model Innovation: It's not just about Technology anymore,* pp. 12-17.
[33] Cf. BRAUN AND WINTER (2007) *Integration of IT Service Management into Enterprise Architecture*, pp. 1216-1218; BRAUN AND WINTER (2005) *A comprehensive Enterprise Architecture Meta Model and its Implementation using a Meta Modeling Platform*, pp. 70-73; BOUWMAN ET AL. (2012) *Business Models Tooling and a Research Agenda*, pp. 235-257; TERAI ET AL. (2002) *Business Process semi-automation based on Business Model Management*, pp. 215-234.
[34] Cf. PROPER ET AL. (2018) *Architectural Coordination of Enterprise Transformation*, pp. 1-4; AIER AND SCHÖNHERR (2006) *Status quo geschäftsprozessorientierter Architekturintegration*, pp. 189-190.
[35] Cf. STAPLES ET AL. (2007) *An exploratory Study of why Organizations do not adopt CMMI*, pp. 883-895.

of both, business model components[36] as well as the underlying business processes. A semantic and machine-readable representation in the form of an ontology enables semantic annotations and reasoning techniques that facilitate an intelligent tool support, e.g. in terms of detecting constraints or conflicts in business processes and the accompanying impact on the affected business model components. A semantic representation of business models in the form of an ontology has the advantage that it enriches itself over time, which comes along with an improvement of company-specific recommendations regarding the underlying business model.

Semantics in business model research IS and strategic management researchers developed ontologies for modeling formal aspects of an enterprise by providing the vocabulary and constraints for describing the environment in which business processes are carried out.[37] There also exist formal concepts with a focus on specific application domains that provide a conceptual description of economic exchange among partners.[38] Ontologies like the Bunge-Wand-Weber Ontology[39] focus on the evaluation of the grammars of several IS modeling methods like UML, etc., whereas REA[40] (Resource-Event-Actor) depicts the semantics of the collaborative space between enterprises where market exchanges among two or more trading partners occur.[41]

Semantics in BPM In the literature, several approaches for the semantic representation of business processes have been proposed, e.g. by enhancing existing modeling languages like BPMN and EPCs.[42] The main goal of these approaches is to enable an automation of the BPM cycle by applying the integrated semantics in each of its phases. By this means, business processes can be represented in a machine-readable representation and hence, support phases like business process design, modeling, etc. Semantic Business Process Management focuses on the generation of meaningful results from business processes by applying reasoning techniques on process models and process executions.[43] It aims at increasing the level of automation in business process management by applying semantic web services frameworks and ontology languages to support reasoning techniques during the execution and analysis of business processes.[44]

Research Gap 2 Although there exist several formal descriptions of organizational activities, so far, none of these approaches addresses business models in the software industry. Thus, the detailed

[36] Cf. Chapter 2.2.3 for a definition and exemplification of business model components.
[37] For instance FOX AND GRUNINGER (1998) *Enterprise Modeling*, pp. 117-118; FOX ET AL. (1998) *An Organization Ontology for Enterprise Modelling*, pp. 138-142; GRUNINGER, ATEFI AND FOX (2000) *Ontologies to support Process Integration in Enterprise Engineering*, pp. 382-390.
[38] GORDJIN ET AL. (2000) *Business Modelling is not Process Modelling*, p. 46; GORDIJN (2003) *Value-based Requirements Engineering - Exploring innovative E-Commerce Ideas*, pp. 121-130.
[39] Cf. WAND AND WEBER (1990) *An Ontological Model of an Information System,* pp. 1282-1292; WAND AND WEBER (1993) *On the ontological Expressiveness of Information Systems Analysis and Design Grammars*, pp. 217-237. The authors apply the BWW representation model to the classical descriptions of ER modeling and logical data flow diagramming. The authors highlight in both modeling grammars instances of ontological incompleteness and deficiencies in ontological clarity; GREEN AND ROSEMAN (2000) *Integrated Process Modeling: An Ontological Evaluation*, pp. 73-87.
[40] Cf. MCCARTHY (1982) *The Rea Accounting Model: A generalized Framework for Accounting Systems in a shared Data Environment*, pp. 554-578.
[41] Cf. GEERTS (1999) *An Accounting Object Infrastructure for knowledge-based Enterprise Models*, pp.89-94.
[42] Cf. FILIPOWSKA ET AL. (2009) *Organizational Ontologies to support semantic Business Process Management*, pp. 35-42; HEPP AND ROMAN (2007) *An Ontology Framework for semantic Business Process Management*, pp. 432-437.
[43] Cf. HEPP ET AL. (2005) *Semantic Business Process Management: A Vision towards using semantic Web Services for Business Process Management*, pp. 538-539.
[44] Ibid.

linking of business processes and business models for the software industry is not applicable in a machine-readable representation. However, this is required for an automated consideration of process information in the design and monitoring phase of business models. Thus, a formal representation of relevant aspects on the layers of business processes and business models is needed.[45]

Business model research is classified into four research fields:[46] 1) characteristics, 2) empirical analysis, 3) evaluation models and 4) tools. The first research field focuses on the constituent elements of a business model by dividing each element into several choice options, which represent the characteristics of the business model elements.[47] These characteristics can be examined by carrying out empirical analyses, whereas the data from these analyses forms the basis for statistical evaluations.[48] Tools focus on the representation of relevant information from business models to users with the goal to make the business model concept useful for practitioners.[49] VEIT ET AL. emphasize the need for tool support in business model research (e.g. to develop or analyze business models), which has been identified as one of the three major lines of business model research in IS research.[50] The practical need for requirements is further emphasized by results of the requirement analysis carried out in this thesis (Section 3.4), which are summarized in Table 3.3. Within the business model tooling field, several tools were implemented that support the following functionalities:

Business Model Composition and Adaptation STRATEGYZER[51] supports the design of business models from scratch according to the building blocks of the Business Model Canvas (BMC). Another tool that supports the composition of business models for the software industry by taking into account relevant market data is the Software Business Model Wizard.[52]

Business Model Analysis Most available tools like e^3 Value Editor[53] are still in their infancy and thus largely restricted to rudimentary support for financial calculations and business model visualization.[54] Tools like ARIS Performance Manager[55] support the controlling of business processes, but without carrying out a mapping to a company's business model. ARCHIMATE is a modeling language that supports the description, visualization and analysis of enterprise architectures within and across business domains. It supports the construction and operation of information flows, IT systems, technical infrastructures, organizational structures and business processes.[56]

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[45] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, p. 56.
[46] Cf. SCHIEF (2014) *Business Models in the Software Industry: The Impact on Firm and M&A Performance*, p. 5.
[47] Cf. BACHARACH (1989) *Organizational Theories: Some Criteria for Evaluation*, pp. 496-515.
[48] Cf. SCHIEF (2014) *Business Models in the Software Industry: The Impact on Firm and M&A Performance*.
[49] Cf. BURKHART ET AL. (2012) *A comprehensive Approach towards the structural description of Business Models*,pp. 88-102; KUNDISCH ET AL. (2012) *Approaches for Business Model Representation: An Overview*, pp. 4-12.
[50] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, p. 61. Further research fields according to these authors are *Business Models in IT industries* & *Digital Business Models*
[51] https://strategyzer.com, accessed on 07-23-2018.
[52] Cf. SCHIEF (2014) *Business Models in the Software Industry: The Impact on Firm and M&A Performance*, pp. 174.
[53] Cf. GORDIJN AND AKKERMANS (2003) *Value-based Requirements Engineering: Exploring innovative e-Commerce Ideas,* pp. 114-134.
[54] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, p. 60; CASPAR ET AL. (2013) *Vom Geschäftsmodell zum Geschäftsprozess und zurück - Konfiguration, Analyse, Transformation, Controlling*, p. 16; DI VALENTIN ET AL. (2013) Conceptual Integration of Business Model Transformations and Business Process Management, pp. 19.
[55] http://www.softwareag.com, accessed on 07-23-2018.
[56] Cf. THE OPEN GROUP (2017) *ArchiMate 3.0.1 Specification*. Cf. Annex E for an overview of ARCHIMATE.

Research Gap 3 Expected research goals in terms of tooling should focus on a continuous and intelligent analysis of business model parameters (components) and their underlying business processes in order to provide company-specific recommendations for business model adaptation based on the analysis results. Therefore, an integration of the formal aspects of Research Gap 2 into an overall concept is required. To date, this research domain has been scarcely addressed.[57]

The thesis addresses these research gaps with the design of a reference model for business model analysis and adaptation in the software industry. Therefore, the constituent elements of business models in the software industry are elaborated and represented in form of semantic/ontological concepts that are linked to process artifacts from reference processes of value-creating activities in the software industry. The semantic linking between business model layer and business process layer forms the foundation for the development of a business model analysis system that supports the derivation of recommendations for business model adaptation based on the achieved objectives on the process layer. Figure 1.2 visualizes the course of analysis applied in this thesis and shows the developed content blocks and how they contribute to each other throughout the design of the reference model.

1.2 PROBLEM STATEMENT

The research context has shown that the increasing significance of the digital economy has made the business model concept a relevant unit of analysis.[58] In order to stay competitive and to retain a certain level of flexibility, it is crucial for software companies, and firms in general, to adapt their business model to operational information from process executions. Companies need to be able to transform their strategic decisions reflected in the business model into feasible business processes, and conversely, use the knowledge gained through process execution for the redesign of the underlying business model. Therefore, relevant information from the process layer needs to be used as a feedback indicator for the quality of the business model. This requires a dedicated elaboration of business model components in the software industry and their assignment to corresponding process artifacts in order to develop an intelligent application system that supports a machine-readable representation of the elaborated links between business model and business process layer. To appropriately address the domain-dependent characteristics, the domains addressed with this thesis are business model components and business processes in the software industry.

The conceptual design of generic[59] and software industry-specific[60] business models has been the subject of several scientific contributions in the IS and management domain. Most publications focus on the description of the relationships of generic business model elements to each other, e.g. in the form

[57] Cf. DI VALENTIN, WERTH AND LOOS (2015) *Analysis of IT-Business Models towards Theory Development of Business Model Transformation and Monitoring*, pp. 1-2.
[58] Cf. LAMBERT AND DAVIDSON (2012) *Applications of the Business Model in Studies of Enterprise Success, Innovation and Classification: An Analysis of empirical Research from 1996 to 2010*, pp. 669-670.
[59] For instance ZOTT, AMIT AND MASSA (2011) *The Business Model: Recent Developments and future Research*; AL-DEBEI AND AVISON (2010) *Developing a unified Framework of the Business Model Concept*; DI VALENTIN ET AL. (2012) *Conceiving Adaptability for Business Models: A literature-based Approach*; BURKHART ET AL. (2011) *Analyzing the Business Model Concept: A comprehensive Classification of Literature*.
[60] For instance BONACCORSI, GIANNANGELI, AND ROSSI (2006) *Entry Strategies under Competing Standards: Hybrid Business Models in the Open Source Software Industry*; RAJALA AND WESTERLUND (2012) *The Effects of Service Orientation, Technology Orientation and Open Innovation on the Performance of software-intensive Service Businesses*; SCHIEF (2014) *Business Models in the Software Industry: The Impact on Firm and M&A Performance*.

of taxonomies.[61] To date, research has predominantly addressed a component-based view of business models,[62] which results in shortcomings in the analysis of the dynamics that permanently influence business models.[63] Thus, even though "business model tooling" represents a major domain of business model research, to date, this field has been scarcely addressed.[64]

Recommender systems support complex decision-making by reducing the number of possible entities through context-sensitive recommendations. Particularly for the "business model tooling" research domain,[65] recommender systems represent a promising solution as the relation of business model elements among each other and on underlying business processes is a highly dynamic and complex unit of analysis. The use of a recommender system for business model analysis would support software companies in adapting their business models to their value-creating activities as well as to current market conditions.

This thesis addresses the identified research gaps[66] with the development of a reference model for process-driven business model analysis and adaptation. Therefore, the relationships between business model components and business process artifacts in the software industry are analyzed in terms of top-down and bottom-up transformations. The derived software business model elements and process artifacts are formalized and semantically linked through a set of process KPIs that is elaborated per business model element. Selected parts of the reference model are implemented in the form of an application system (Business Model Monitoring System – BMMS) to demonstrate the proof of concept.

Research benefits through the developed top-down and bottom-up mapping methodology that serves as a blueprint for other industries and contributes to dynamic business model research. Furthermore, research benefits through the breakdown of the elaborated software business model elements into properties and characteristics that form the basis for the ontology-based formalization of the Software

[61] Cf. TIMMERS (1998) *Business Models for Electronic Markets*, pp. 3-4; MAHADEVAN (2000) *Business Models for internet-based E-Commerce: An Anatomy,* pp. 55-69; TAPSCOTT, LOWI AND TICOLL (2000) *Digital Capital – Harnessing the Power of Business Webs*; RAPPA (2004) *The Utility Business Model and the Future of Computing Service*, pp. 35-37; LINDER AND CANTRELL (2000) *Changing Business Models: Surveying the Landscape,* pp. 3-8; KAPLAN AND SAWHNEY (2000) *E-Hubs: The New B2B Marketplaces,* pp. 71-79; WEILL AND VITALE (2001) *Place to Space: Migrating to eBusiness Models*; APPLEGATE AND COLLURA (2001) *Emerging Networked Business Models: Lessons from the Field*.

[62] Cf. RITTER AND LETTL (2018) *The wider Implications of Business Model Research*, pp. 1-8; MAHADEVAN (2002) *Business Models for internet-based E-Commerce: An Anatomy*, pp. 10-22; HAMEL (2002) *Leading the Revolution*; LINDER AND CANTRELL (2000) *Changing Business Models: Surveying the Landscape*; CHESBROUGH AND ROSENBLOOM (2002) *The Role of the Business Model in capturing Value from Innovation: Evidence from Xerox Corporation's Technology Spin-off Companies*, pp. 530-535; AFUAH AND TUCCI (2004) *Internet Business Models and Strategies: Text and Cases,* p. 54; PETROVIC, KITTL AND TEKSTEN (2001) *Developing Business Models for eBusiness*, p. 3; OSTERWALDER, PIGNEUR AND TUCCI (2005) *Clarifying Business Models: Origins, Present, and Future of the Concept*, pp. 17-18; HEDMAN AND KALLING (2003) *The Business Model: A Means to understand the Business Context of Information and Communication Technology,* pp. 9-10; MAGRETTA (2002) *Why Business Models matter,* pp. 90-92; MASSA, GIANLUIGI AND TUCCI (2018) *Business Models and Complexity*, pp. 63-65; APPLEGATE AND COLLURA (2001) *Emerging networked Business Models: Lessons from the Field*.

[63] Cf. MASSA, GIANLUIGI AND TUCCI (2018) Business Models and Complexity, pp. 60-61, MCGRATH (2010) *Business Models: A discovery-driven Approach*, pp. 253-254.

[64] Cf. DI VALENTIN, WERTH AND LOOS (2015) *Analysis of IT-Business Models towards Theory Development of Business Model Transformation and Monitoring*, p. 2; BURKHART ET AL. (2011) *Analyzing the Business Model Concept: A comprehensive Classification of Literature*, p. 2.

[65] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, p. 6. The authors present "IT Support for Developing and Managing Business Models" as one of the research perspectives on business models.

[66] Cf. Section 1.1.

Business Model (SW-BMO), which enables the establishment of the semantic linking between the business model and the process layer. The implementation of the SW-BMO provides the technical foundation for an application system that supports company-specific recommendations for the optimization of business models. Practitioners benefit from the possibility to formalize their business model during the design and monitoring phase. Depending on the configured business model, the system supports the assignment of matching KPIs that enable a continuous monitoring of a given business model. The implemented semantic relationships of the semantic business model and the corresponding process artifacts supports the derivation of recommendations for business model adaptation based on the analysis of operative information from process executions. The main target group of the reference model implementation is decision-makers and analysts in the software industry.

1.3 RESEARCH QUESTIONS

The scientific interest that emerges from the initial situation leads to the following research questions that are addressed with this thesis:

First Research Question: What are the requirements for process-driven business model analysis and adaptation in the software industry?

Motivated by the broad application field of business model research such as generic business models and business models in the software industry, as well as related domains like Enterprise Architecture and Business Process Management, the first research question focuses on the delimitation of the business model terminology and the identification of the pertinent state of the art within the related research domains that are relevant for process-driven business model adaptation. The analysis of the related work serves as a basis for the derivation of requirements for process-driven business model adaptation.

Second Research Question: What are the components of business models and business processes in the software industry and how can they be structured and systematically described?

The second research question focuses on the structured description of the software industry domain. What type of business model components and specifications are typical for business models in the software industry? How can the interdependencies and dynamics between software industry-specific business model elements be described in the form of semantics? Which business model elements are particularly relevant for the strategic success of software firms? Which business model elements are particularly close to the execution of software business processes? The structured description of the software industry domain serves as a basis for the third research question.

Third Research Question: How can operative information from process executions be dynamically linked to the strategic objectives defined in a software business model?

Which operational key figures of processes in the software industry can be linked to the elaborated software business model elements? How do methods like Business Intelligence, Process Mining and Business Activity Monitoring contribute to decisions for the dynamic adaptation of software business models? The systematic elaboration of these links supports the design of an application system for process-driven business model monitoring and adaptation. The research question is answered from a design science-oriented approach in the light of information system development by developing an artifact that mediates between the requirements that are answered with the first and second research question and the practical application (implementation) of the fourth research question.

Fourth Research Question: Can the reference model be realized in the form of an application system that supports recommendations for process-driven business model analysis and adaptation?

The fourth research question validates the practical relevance of the third research question. It analyzes whether the semantic relationships can be implemented in the form of an application system that supports the derivation of recommendations for business model adaptation based on the elaborated semantic relationships between business processes, process KPIs and specific business model instantiations.

1.4 Design Science Research Methodology

After having focused for several years on discussions about the definition and classification of business models, nowadays, research activities predominantly address aspects of capturing, designing and analyzing business models.[67] Therefore, researchers apply both a behavioristic as well as a design science-oriented approach. Business model configuration as a research topic is a typical example of a behavioristic research approach, whereas the testing of innovative and technology-driven business models represents a design-oriented approach.[68]

The research method applied in this thesis follows a design science-oriented approach according to the guidelines of Hevner et al.[69] Design science research (DSR) has the intention *"[…] to solve problems by introducing into the environment new artifacts, the availability of which will induce their spontaneous employment by humans and thus, coincidentally, cause humans to abandon their previous problem-producing behavior and devices."*[70] Following theory-driven research, this thesis focuses on the identification of constructs and the relationships among these constructs.[71] This chapter discusses the DSR methodology adopted in this thesis as well as the developed design artifacts.

Design as an Artifact From a DSR project, four major types of design artifacts are expected as research outputs:[72] 1) construct, 2) model, 3) method, and 4) instantiation. A *construct* contains a vocabulary or symbols for the description and definition of artifacts and phenomena. *Models* describe abstractions and representations under the consideration of the developed constructs. *Methods* can contain algorithms and practices that use the developed constructs and models. *Instantiations* represent implementations (prototypes) of the developed methods and models with the goal to apply the developed artifacts in a practical context. To solve the research problem, the research field needs to be addressed in a multi-faceted manner. Table 1.1 depicts the design-science artifacts that are developed in the course of this thesis. Methods and Evaluation describe the research activities and the evaluation of the developed artifacts. The column Outcome depicts how the developed artifacts interact and build upon each other in the overall developed concept.

[67] Cf. Hess et al. (2012) *Geschäftsmodelle als Thema der Wirtschaftsinformatik*, p. 3.
[68] Ibid.
[69] Cf. Hevner et al. (2004) *Design Science in Information Systems Research*, pp. 75-105.
[70] Buckminster Fuller (1992) *Cosmography: A posthumous Scenario for the Future of Humanity*, p. 8.
[71] Cf. Andersen and Hepburn (2016) *Scientific Method*; Maass et al. (2018) *Data-driven meets theory-driven Research in the Era of Big Data: Opportunities and Challenges for Information Systems Research*, p. 1254; Andersen and Hepburn (2016) Scientific Method.
[72] Cf. Hevner et al. (2004) *Design Science in Information Systems Research*, pp. 82-84.

Table 1.1 Applied methodology for the development of the DSR Artifacts

Artifact	Method and Evaluation		Outcome
	Method	**Evaluation**	
Software Business Model (Construct)	• Review of existing research about the constituent components of business models in the IS and management domain • Analysis and classification of generic and software industry-specific business model components • Consolidation of the findings into a Business Model Framework that depicts the core business model components of the software industry	*Quantitative literature study*	• Software business model framework that considers business model research streams in IS and management research • Forms the basis for the development of the business model ontology • Starting point for mapping to process layer • Central component of the BMMS
Requirements Catalog (Construct)	• Requirements derivation for tool support in terms of business model evaluation and business model adaptation based on the shortcomings of the state of the art • Expert interviews (qualitative study) about performance measurement in software firms • Deductive literature study based on verifications from the expert interviews	*Qualitative evaluation* of the derived requirements in the form of expert interviews with C-level representatives (inductive analysis) to enhance the theoretical findings according to real-world problems	*Requirements Catalog* for • The design of the BMMS • Representation of business model- and process-related aspects • The transformation between business model and process layer (top-down and bottom-up)
Software Business Model Domain Ontology (Model and Instantiation)	Review of the state of the art of business model ontologies and taxonomies: • Consolidation of relevant aspects into the Software Business Model Domain Ontology • Integration of domain-specific aspects into the ontology (Software Business Model, value- creating activities in the software industry)	*Quantitative and qualitative evaluation* in the form of expert interviews with representatives from the software industry (C-level).	Software Business Model Ontology that: • Can be adapted and expanded to future research on business models • Can be adapted to more specified domains within the software industry (e.g. exclusive focus on software maintenance, etc.) • Provides suitable interfaces to the process layer
Reference Model for process-driven business model analysis	Methodology for business model monitoring and analysis based on business processes (top-down and bottom-up)	*Quantitative evaluation of:* • The identified value-creating activities in the software industry (1) • The developed mapping of the value-creating	Identification of the coherence between the software business model components and the value-creating

and adaptation (Method)	• Identification of the core value-creating activities in the software industry (1) • Qualitative mapping of the derived artifact "Software Business Model" with the value-creating activities of the software industry (2) • Classification of relevant KPIs to the elements of the Software Business Model (3) How can the information from the process layer be adequately considered in the Software Business Model? (4)	activities to the components of the Software Business Model (2) • *Qualitative evaluation* in the form of workshops with practitioners in the software industry to: • Cross-check the developed mapping mechanism from the process layer to the business layer (2) • Identify relevant KPIs for each activity of the software industry value chain (3) Develop an adequate methodology for representing business model-relevant information from the process layer to decision-makers (4)	activities on the business process layer *Top-down*: What impact do business model configurations have on the process layer? *Bottom-up*: How can information from the process layer be considered for decisions about the business model?
BMMS (Instantiation)	Development of a tool that integrates the developed semantic artifacts and that supports business model analysis and adaptation	Proof of Concept (4)	The BMMS helps practitioners in the software industry to analyze their business model and carry out optimizations on the business model

The *Software Business Model* artifact forms a central aspect for the artifact *Software Business Model Ontology (SW-BMO)*. The artifact *SW-BMO* contains the domain knowledge that facilitates the generation of recommendations for business model adaptation. The specifications of the artifact *Requirements Catalog* are considered for the development of the *reference model for process-driven business model analysis and adaptation*.

Problem Relevance The objective of DSR is to develop technology-based solutions for important and relevant business problems.[73] The need for tool support in terms of business modeling has been identified as one of the three major research trends in business model research.[74] In order to identify the relevance of the business problem, a review of the state of the art in management and IS-related literature has been conducted. The review revealed that there is a lack of research that focuses on the relationship between business models and business processes. These findings have been verified by workshops and interviews with decision-makers in the software industry that were carried out during the research project SWINNG.[75] The workshops and interviews revealed the missing link between business models and business processes (theoretical/conceptual as well as in the form of tool support). Based on the findings regarding the state of the art, a clear *design objective* and a *justified research gap of high practical and scientific relevance* could be defined. Furthermore, the *requirements* for the artifact have been derived based on these findings.

[73] Cf. HEVNER ET AL. (2004) *Design Science in Information Systems Research*, pp. 84.
[74] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, p. 58.
[75] SWINNG was fund by the German Federal Ministry of Education and Research (BMBF) under the grant 01IC10S05A; cf. Section 1.5.2.

Design Evaluation To ensure the rigor and relevance of the design artifacts, well-designed evaluation steps need to be carried out to validate their functionality, accuracy, and efficiency.[76] In this thesis, a combination of different evaluation methods (qualitative, proof-of-concept) has been applied (cf. Table 1.1).

Research Contributions Effective DSR needs to provide clear and verifiable contributions in the areas of design artifacts, design foundations and design methodologies.[77] The outcomes of DSR must be clear and verifiable, with respect to design artifacts, foundations, and methodologies.[78] As stated in *Problem Relevance*, the contributions of this work are clear and valid. The developed artifacts focus on the software industry. However, the developed conceptual foundations serve as a blueprint for other domains.

Research Rigor DSR relies on the application of rigorous methods in both the construction and evaluation of the design artifact.[79] To ensure and evaluate the practical applicability of the developed artifacts and in order to show that they are verifiable, several evaluation methods are applied. The problem relevance, the requirements as well as the methodology of business model transformation (top-down) and analysis (bottom-up) are verified in the form of qualitative and quantitative studies.

Design as a Search Process The search for an effective artifact requires the utilization of available means to reach desired ends while satisfying laws in the problem environment. The goal of DSR is to search for *"[…] the best or optimal design, which makes the design science projects inherently iterative."*[80] This thesis adopts an iterative design strategy. First, theoretical artifacts like the Software Business Model Framework, a domain ontology and a mapping methodology from the business model layer to the process layer are developed, which contribute to the development of the reference model. Based on the proposed approach, additional research opportunities, e.g. in terms of enhancing the proposed ontological concepts or providing an interface to different process artifacts, have been revealed.

Communication of Research The last guideline requires DSR to be presented in a way that is understandable for both technology- and management-oriented audiences.[81] The interdisciplinary research results were continuously published in the fields of information systems and computer science. Thus, feedback from the IS as well as computer science community could be constantly considered in the research activities. Furthermore, several evaluations of the developed artifacts are carried out with the representative target groups in the software industry. Intermediate and final results have been constantly communicated within the German Software Cluster.

[76] Cf. HEVNER ET AL. (2004) *Design Science in Information Systems Research*, pp. 85-86.
[77] Cf. GREGOR AND HEVNER (2013) *Positioning and presenting Design Science Research for maximum Impact*, pp. 341-342.
[78] Cf. HEVNER ET AL. (2004) *Design Science in Information Systems Research*, pp. 87.
[79] Ibid., pp. 87-88.
[80] Ibid., pp. 88.
[81] Ibid., pp. 90.

1.5 RESEARCH APPROACH

1.5.1 SCIENTIFIC POSITIONING

Information systems research addresses the design, development and application of computer-based, business information systems.[82] Hence, information systems research has a mediating role between the disciplines of business administration and computer science,[83] which are both tackled in this thesis. The business administration discipline is addressed with the business models research domain and the structured mapping of business model components to reference processes in the software industry in the form of a reference model. The computer science domain is tackled with the implementation of the semantic business model layer and the development of an architecture that allows the development of an application system that supports a context-based analysis and adaptation of business models. The business model as mediator between strategy and business processes as described in Section 1.1 represents the unit of analysis in this thesis.

VEIT ET AL.[84] have developed a research agenda for business models in the IS domain by proposing the categories 1) business models in IT industries, 2) digital business models and 3) IT support for developing and managing business models. This thesis addresses the first and the third pillars of the research agenda.

The mediating role of business models between strategy and business processes[85] is related to the Enterprise Architecture concept.[86] The main goal of enterprise architecture is to support the identification of inconsistencies between performance indicators, strategic goals, business process specifications and application design.[87] The thesis addresses this domain with the development of a concept that supports the redesign of business models according to the underlying processes (bottom-up), and conversely, also supports the implementation of strategic changes on the process layer (top-down). The IS development and application design domain is addressed with the prototypical implementation of the Business Model Monitoring System (BMMS), which is closely tied to the *Computer Science* discipline, particularly to the recommender systems research domain.

Wirtschaftsinformatik is an application-oriented discipline, focusing on the construction, deployment and utilization of information systems.[88] In addition to the design science oriented methodology (cf. Section 1.4), this thesis also follows an application-oriented discipline of German Wirtschaftsinformatik (WI), which involves "research through development".[89] Results in Wirtschaftsinformatik focus on utility by evaluating the contribution of the developed research to real-world problems, which represents the starting point for the construction and analysis of future realities.[90]

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[82] Cf. SCHEER (1998) *Wirtschaftsinformatik: Referenzmodelle für industrielle Geschäftsprozesse*, p 1.
[83] Cf. SCHEER (1999) *ARIS: Business Process Frameworks*, pp. 33.
[84] Cf. VEIT ET AL. (2014) *Geschäftsmodelle – Eine Forschungsagenda für die Wirtschaftsinformatik*, pp. 55-63.
[85] Cf. PETROVIC, KITTL AND TEKSTEN (2001) *Developing Business Models for eBusiness*, pp. 2-3; AL-DEBEI, EL-HADDADEH AND AVISON (2008) *Defining the Business Model in the new World of digital Business*, pp.8-9.
[86] Cf. AIER, RIEGE AND WINTER (2008) *Unternehmensarchitektur - Literaturüberblick und Stand der Praxis*, pp. 292-304.
[87] Cf. BRAUN AND WINTER (2005) *A Comprehensive Enterprise Architecture Metamodel and its Implementation using a Meta Modeling Platform*, p. 66; AIER, RIEGE AND WINTER (2008) *Unternehmensarchitektur - Literaturüberblick und Stand der Praxis*, p. 292.
[88] Cf. FRANK (2006) *Towards a pluralistic Conception of Research Methods in Information Systems Research*, p. 1.
[89] Ibid., p. 5.
[90] Cf. ULRICH (1981) *Die Betriebswirtschaftslehre als anwendungsorientierte Sozialwissenschaft*, pp. 1-25.

Thus, this thesis follows a design science-oriented[91] as well as an application-oriented approach[92] by developing an application system for a given business reality.[93] The thesis thereby makes use of innovative technology, which facilitates the development of new business realities.

1.5.2 SCIENTIFIC INVESTIGATION

The requirements of the reference model for process-driven business model analysis and adaptation have been derived on the basis of an analysis of relevant scientific theories and concepts as well as by following an inductive research approach of grounded theory.[94] This is because the combination of quantitative and qualitative insights supports the development of a theory that is cleary-defined and which is capable to describe its applicability.[95] The findings of the literature analysis have been summarized into a framework for the review of the state of the art. The shortcomings of the state of the art have been consolidated into a requirement catalog that has been cross-checked for practical relevance and adequacy by means of a qualitative study with the relevant target groups in the software industry (inductive).

The design methodology for the literature analysis is derived from generally accepted theories, following an argumentative-deductive approach.[96] The dissertation has been accompanied by the research project SWINNG – Process Innovations in the Software Industry, which was funded by the German Federal Ministry of Education and Research (BMBF) under the grant number 01IC10S05A. SWINNG focused on innovative business models for the economic exploitation of software. The evaluation of the theoretical concepts, as well as their prototypical implementation, has been carried out with partners of the German Software Cluster.[97]

1.6 STRUCTURE OF THE THESIS

Figure 1.2 illustrates the course of analysis applied in this thesis. Following the introduction of the research context, the research problem and the applied research method, **Chapter 2** defines the foundation of the business model concept by first providing an overview of the evolution in business model research and a summary of widely-applied definitions of the business model terminology. Research results for the classification of business model components (constituent business model elements) are presented, followed by a delimitation of the concept of strategy vs. the concepts of business models and business processes. The latter, especially, represents a fundamental aspect for the remainder of this thesis.

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[91] Cf. HEVNER ET AL. (2004) *Design Science in Information Systems Research*; GREGOR AND HEVNER (2013) *Positioning and Presenting Design Science Research for maximum Impact*; cf. Section 1.4.
[92] Cf. ULRICH (1981) *Die Betriebswirtschaftslehre als anwendungsorientierte Sozialwissenschaft*, pp. 1-25.
[93] Cf. HEINRICH (2007) *Wirtschaftsinformatik: Einführung und Grundlegung*, pp. 13.
[94] Cf. GLASER AND STRAUSS (1967) *The Discovery of Grounded Theory. Strategies for Qualitative Research*, pp. 237.
[95] Cf. CASH (2018) *Developing theory-driven Design Research*, p. 91; SHAH AND CORLEY (2006) *Building better Theory by bridging the quantitative-qualitative Divide,* p. 1832.
[96] Cf. KNOBLICH (1972) *Die typologische Methode in der Betriebswirtschaftslehre*, pp. 141-147; EBERHARD (1999) *Einführung in die Erkenntnis- und Wissenschaftstheorie*; BORTZ AND DÖRING (2002) *Forschungsmethoden und Evaluation,* pp. 355; WILDE AND HESS (2007) *Forschungsmethoden der Wirtschaftsinformatik - Eine empirische Untersuchung*, pp. 282-286.
[97] www.software-cluster.org/, accessed on 11-10-2018.

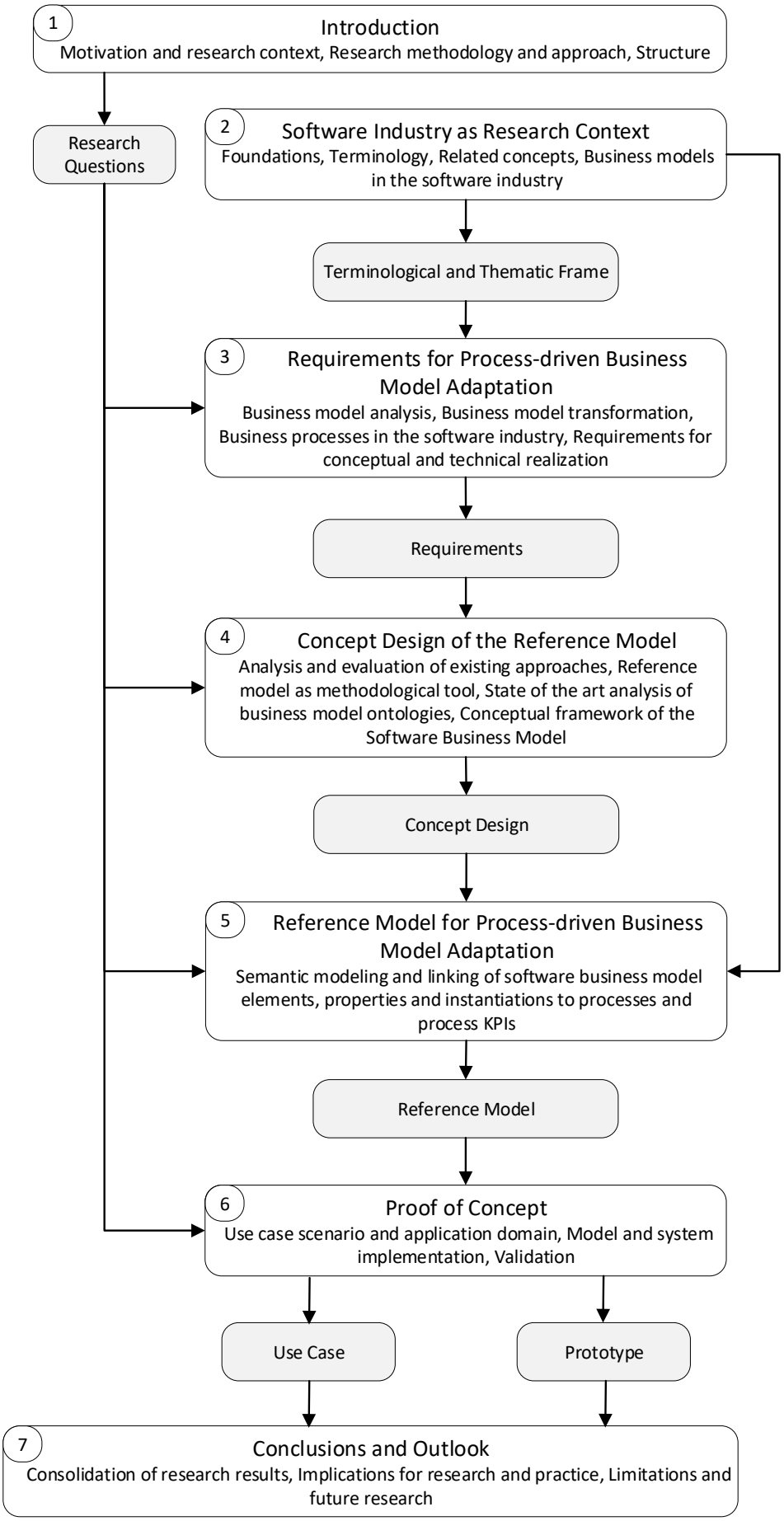

Figure 1.2 Structure of the thesis

Following the generic descriptions of the business model concept, the software industry as research context is introduced by providing an overview of economic characteristics and types of value-creating activities, which is required for the consideration of the process view. Furthermore, a literature analysis of existing research in the field of business models in the IT and software industry is carried out and consolidated into a classification scheme.

Chapter 3 addresses the first research question[98] by deriving the requirements for the reference model for process-driven business model analysis and adaptation. In a first step, theoretical requirements are derived on the basis of shortcomings in the domains of business model adaptation, business model ontologies, and techniques of business model analysis, as well as (semantic) process mining and analysis techniques. The results are consolidated into a requirement catalog that is validated and enhanced with empirical requirements based on a qualitative study with the relevant target groups of the reference model (decision-makers and CEOs in the software industry). The chapter closes with a consolidation of the theoretically and qualitatively derived requirements (second design-science artifact). **Chapter 4** develops the theoretical groundwork for the development of the reference model in the form of a conceptual design. It develops the theoretical underpinnings to address the second research question by elaborating on the purpose, goal and target users of the reference model. This chapter develops the Semantic Software Business Model based on an analysis of the underlying literature in the domain of business model ontologies that provides the conceptual basis for the interface to the process layer. The results of the identification of relevant work are analyzed with regards to applicability and reuse of ontological concepts in the reference model. Relevant concepts from the state of the art are classified into a classification scheme and enhanced with specifics of the software industry that were the subject of the state of the art analysis.

Chapter 5 develops the reference model for process-driven business model analysis and adaptation based on the theoretical groundwork. It first introduces the structure of the reference model, which consists of the Conceptual Frame (business model view), Process View (interface from business model to business process) and Data View (relationships among business model element instantiations), which together represent the functional design. For each business model concept of the Semantic Software Business Model developed in the previous section, this chapter develops the functional design and elaborates the interface to the process layer through a mapping to the corresponding value-creating activities in the software industry. The chapter concludes with an evaluation of the reference model according to the requirements catalog. **Chapter 6** demonstrates the proof of concept with the implementation of the Business Model Monitoring and Adaptation Systems (BMMS) in order to answer the fourth research question. It shows how the reference model supports the realization of a specific use case scenario for the software industry. **Chapter 7** summarizes the outcomes of the thesis, identifies limitations and provides an outlook on implications for further research.

[98] Cf. Section 1.3.

"Research is to see what everybody else has seen, and to think what nobody else has thought."

ALBERT SZENT-GYORGYI

2 RESEARCH FOUNDATIONS

2.1 PRELIMINARIES

This chapter elucidates the related work and the research context of this thesis. In a first step, Section 2.2 introduces the foundations of the business model concept that are established in the IS and management domain. First, the core research streams of the last decades in business model research are described in Section 2.2.1, followed by an overview of the most established definitions and taxonomies in Section 2.2.2. The components of business models like revenue streams or value propositions are outlined in Section 2.2.3. Furthermore, Section 2.2 delimits the business model concept to the concepts of strategy and business processes. The focus of the presented conceptual basics and delimitations to related research fields is generic. The software industry as research context of this thesis is introduced in Section 2.3. Results of a literature review on business models in the software industry are presented in Section 2.4.

2.2 FOUNDATIONS OF THE BUSINESS MODEL CONCEPT

This chapter clarifies the theoretical underpinnings of the business model research domain. It gives an overview of the core research streams in the past decades, as well as of the common definitions of the business model terminology. The goals are to provide a common understanding of the business model concept on which the developed research results are based upon, and to classify the developed results to existing business model research streams. Section 2.2.1 gives an overview of the developments in business model research in the last decades, followed by an elaboration of the different definitions of the business model concept in Section 2.2.2. Section 2.2.3 classifies the components of business models on the basis of a literature review on business model components. Sections 2.2.4 and 2.2.5 differentiate the business model concept from the concepts of strategy and business processes.

2.2.1 DEVELOPMENTS IN BUSINESS MODEL RESEARCH

The business model concept as a research topic has garnered attention among several disciplines, such as Strategic Management, Information Systems, Technology and Innovation Management.[99] A business model is characterized by an abstract relationship to its external environment as well as to the internal value-creation processes.[100] This makes the business model concept a dynamic system that is continuously exposed to environmental influences such as technological trends and innovations. The external environment, which has a constant impact on the success of a business model is also described as a "value network", which consists of customers and partners. It represents a network of correlations in which firms can cooperate in business relationships. Thus, a value network reflects the underlying constellations of the involved actors (value constellations), which mobilize the value creation

[99] Cf. ZOTT, AMIT AND MASSA (2011) *The Business Model: Recent Developments and future Research*, p. 1023.
[100] Cf. PRIEM, WENZEL AND KOCH (2018) *Demand-side Strategy and Business Models: Putting Value Creation for Consumers Center Stage*, p. 24.

process.[101] The term "business model" first appeared in 1957 in the context of the ICT sector, where they supported the documentation of process mappings in the context of the introduction of data processing systems.[102] It took many years, though, until the business model concept moved into the focus of research. Eighteen years later, in 1975, a first indication of the business model concept emerged. From this time onwards the business model concept has been increasingly discussed in research and practice.[103] Between 1997 and 1999, first classifications of the business model concepts that had been elucidated up to this point were discussed in several technological and organizational articles with the elaboration and analysis of various definitions and taxonomies. The increasing interest in the business model concept during this time was generated by the economic bubble that had begun in the late 1990s, and which burst in the early 2000s. During this time, research activities mainly had a focus on the definition and classification of the business model concept,[104] which has manifested in a considerable number of publications.[105]

The year 2003 was another turning point in business model research. The focus switched from the conceptualization of business models to classifications and syntheses of the already-elaborated literature findings. Moreover, the identification and analysis of business model components, reference models and business model ontologies increasingly moved into the spotlight of research. During this time, the business model concept also received greater attention in strategy-oriented publications, instead of having a particular focus on the information systems domain.[106] The current research phase focuses on the completion and extension of business model definitions as well as on the analysis of the constituent components of business models,[107] which is inevitable especially in terms of business model ontologies and reference models.[108] Figure 2.1 summarizes the main phases of business model research from 1975 to the present.

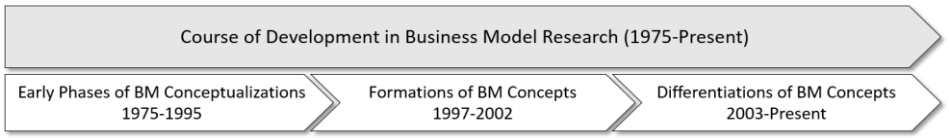

Figure 2.1 Development phases in business model research[109]

[101] Cf. FOSS AND SAEBI (2015) *Business Model Innovation - The Organizational Dimension*, p. 205.
[102] Cf. BELLMAN ET AL. (1957) *On the Construction of Multistage, Multi-Person Business Game*, p. 474; KLEY, LERCH, AND DALLINGER (2011) *New Business Models for electric Cars - A holistic Approach*, p. 3392.
[103] Cf. ZOTT, AMIT, AND MASSA (2011) *The Business Model: Recent Developments and future Research*, pp. 1022-1023.
[104] Cf. TIMMERS (1998) *Business Models for electronic Markets*, p. 4; RAPPA (2001) *Managing the digital Enterprise – Business Models on the Web*, http://digitalenterprise.org/models/models.html, accessed on 08-30-2019.
[105] Cf. SILVA, GOEL AND MOUSAVIDIN (2009) *Exploring the Dynamics of Blog Communities: The Case of Meta Filter*, p. 380.
[106] Cf. WIRTZ (2011) *Business Model Management Design - Instruments - Sucess Factors*, p. 35; GORDIJN, OSTERWALDER AND PIGNEUR (2005) *Comparing two Business Model Ontologies for designing E-Business Models and Value Constellations*, p. 2.
[107] Cf. CHESBROUGH AND ROSENBLOOM (2002) *The Role of the Business Model in capturing Value from Innovation: Evidence from Xerox Corporation's Technology Spin-off Companies*, pp. 6; LINDER AND CANTRELL (2000) *Changing Business Models: Surveying the Landscape*, pp. 2-3; PETROVIC, KITTL AND TEKSTEN (2001) *Developing Business Models for E-Business*, pp. 3-4.
[108] Cf. GORDIJN (2003) *Value-based Requirements Engineering - Exploring innovative e-Commerce Ideas*; OSTERWALDER (2004) *The Business Model Ontology - A Proposition in a Design Science Approach*, pp. 2-3.
[109] Cf. WIRTZ (2018) *Business Model Management Design - Instrumente - Erfolgsfaktoren von Geschäftsmodellen*, pp. 25-26; GORDIJN, OSTERWALDER AND PIGNEUR (2005) *Comparing two Business Model Ontologies for designing E-Business Models and Value Constellations*, p. 2.