TOWARDS EFFECTIVE AND EFFICIENT BUSINESS MODEL CHANGE

OPPORTUNITIES AND CHALLENGES FOR SOFTWARE-INTENSIVE PRODUCT DEVELOPMENT COMPANIES

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Department of Software Engineering
Towards Effective and Efficient Business Model Change
Opportunities and Challenges for Software-Intensive Product Development Companies

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Towards Effective and Efficient Business Model change - opportunities and challenges for software-intensive product development companies

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Abstract

Digitalization initiates and drives significant changes to the process level, organization level, and business level of software-intensive product development (SIPD) companies and their customers. Digitalization creates new opportunities through digital transformation strategies of the business environment. Digitalization also significantly reduces the turnaround-time on a transaction, driving new challenges for the alignment of business and technology changes. For a successful business model realization, a company must understand what capabilities the organization has (in staff and products), what is required, and more importantly, how to turn these capabilities into good-enough abilities without disturbing the effectiveness and efficiency of the daily operations. Integrating the product and service development and the value delivery with a learning organization is critical for efficient business model change (BMCh).

This thesis seeks to develop conceptual models for how BMCh is linked to value, learning organization design, and the transformation of capabilities into abilities derived from business model activities and actor interactions. Such conceptual models facilitate to investigate and identify critical mechanisms and capabilities needed to effectively and efficiently manage BMCh at full scale for SIPD companies, allowing them to exploit the on-going digitalization, may it be through (disruptive) business model innovation, technology innovation, or by continuously adapting and evolving the business operations.

I use the SIPD company as the unit of analysis, with the dual-lens of value and knowledge, set in the context of a business model and how the value creation and capture are influenced by the interaction between two actors performing a business model activity. I build on the business model literature and infuse theories for knowledge creation, learning organizations, and contractual promises to create value. Conducting a cross-disciplinary literature review, followed by a synthesis of related literature, industry best-practices, and an associated design science study, my propositions were validated in a longitudinal case study exploring a
service industrialization program in the telecommunication industry.

I have produced five conceptual models and seven propositions as a start to be able to support the design of a governance mechanism, as the critical engine for both the learning organization and effective and efficient BMCh. The industry now explores the models found during the case study.

My synthesis shows a need for further research into BMCh regarding early detection and measurements of gaps in value, gaps in knowledge, ambiguity, equivocality, and abilities. Flexible role-based governance views present the measurements, as part of the governance mechanisms for full-scale, effective, and efficient BMCh. Further, I also aim to implement such governance mechanisms in software, by using the associated research in intent-driven systems. In the meantime, I propose industry to build knowledge and experience related to the seven propositions.
Acknowledgments

I extend my sincere gratitude to my managers at Ericsson for their continuous support and belief in me. If it weren’t for you Kennet and Niklas, I wouldn’t have started this incredible journey and experience. The same goes for my professor Tony, my manager Joakim, and to Galina, who always encouraged me and helped me to overcome hurdles and find energy when I thought it was nowhere to be found.

To my supervisor Krzysztof, and my dear colleague Johan, if it weren’t for you, there would be no thesis today. I’m so impressed by your constant encouragements, brainstorming, and relentless work to coach me. Not only did it land me a Licentiate, but you also gave me friends for life. Special recognition is also directed to Lars, for pointing me in the right direction with invaluable advice in the business and management research area. To all my colleagues at Ericsson and BTH, no one mentioned no one forgotten, thank you for engaging in discussions and listening to my sometimes endless monologues. It was through these interactions new insights were made, making this thesis possible.

Also, I wish to extend my deepest gratitude to my sister-in-law and my brother for the insights and support received during late-night discussions and hearty breakfasts which opened up and helped me refine my ideas and apply my research in totally different fields, strengthening my belief in my research even further.

However, if it weren’t for my wife Janet, who has always and always stood by me, in pain, sorrow and happiness, in an ever-twisting rollercoaster, I would not have had the strength to finish this thesis.

Thank you all for being part of my life-changing journey!
Preface

0.1 Papers in this thesis

This compilation thesis includes the following four papers.


**PAPER 3:** @ [2018] IEEE. Reprinted, with permission, “Towards Multi-context Goal Modeling and Analysis with the Help of Intents”, Magnus Wilson and Krzysztof Wnuk, conference proceedings MoDRE-18, The 8th International Workshop on Model-Driven Requirements Engineering (MoDRE) (Accepted). [163]

**PAPER 4:** “The implications of digitalization on business model change”, Magnus Wilson, Krzysztof Wnuk, and Lars Bengtsson, Journal (Submitted).

We recommend you cite the publisher’s published version with URL Paper2: http://dx.doi.org/10.1997/978-3-030-02131-3_26
Paper3: http://dx.doi.org/10.1109/MoDRE.2018.00015
0.2 Contribution statement

Magnus Wilson is the lead author of all the papers in this thesis. As the lead author, I took the main responsibility in designing the studies, collecting and analyzing data, and reporting the findings in peer-reviewed publications. Furthermore, I am the sole author of Chapter 1 to Chapter 5. The co-authors’ contribution are described below.

**PAPER 1**, see Chapter 6. Krzysztof Wnuk and Tony Gorschek contributed with valuable methodology support during the whole study. Krzysztof Wnuk contributed in 3rd screening step and the Kappa analysis, as well as with valuable comments during the analysis of the results. Johan Silvander not only directed me to important theories, but also contributed with valuable comments during the initial study design and the analysis of the results. Krzysztof Wnuk, Lars Bengtsson, and Tony Gorschek reviewed and commented on intermediate versions and the final draft of the paper.

**PAPER 2**, see Chapter 7. Krzysztof Wnuk contributed with valuable comments during the analysis of the results. He reviewed and commented on intermediate versions and the final draft of the paper.

**PAPER 3**, see Chapter 8. Krzysztof Wnuk contributed with valuable comments during the synthesis of the results. He reviewed and commented on intermediate versions and the final draft of the paper. Johan Silvander provided with significant contributions to the synthesis via our collaboration of his paper [153].

**PAPER 4**, see Chapter 9: Krzysztof Wnuk and Lars Bengtsson suggested important changes to the structure of the paper, and contributed with valuable comments during the synthesis of the results. They reviewed and commented on intermediate versions and the final draft of the paper.

0.3 Related papers not included in this thesis


0.4 Funding

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<td>3G</td>
<td>Third generation of mobile telecommunication standard</td>
</tr>
<tr>
<td>5G</td>
<td>Fifth generation of mobile telecommunication standard</td>
</tr>
<tr>
<td>[Px]</td>
<td>Reference to Paper X of the selected papers in the SLR</td>
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<tr>
<td>AI</td>
<td>Artificial Intelligence</td>
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<tr>
<td>BC</td>
<td>Benefit and Challenge</td>
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<tr>
<td>BDI</td>
<td>Belief-Desire-Intention</td>
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<td>BF</td>
<td>Business Flexibility</td>
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<td>BI</td>
<td>Business intent [153]</td>
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<td>BM</td>
<td>Business modeling</td>
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<tr>
<td>BMa</td>
<td>Business model Activity</td>
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<td>BMI</td>
<td>Business model innovation</td>
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<tr>
<td>BMC</td>
<td>Business Model Canvas. A template for representing business models [118]</td>
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<tr>
<td>BMCh</td>
<td>Business Model Change</td>
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<tr>
<td>BMCh AM</td>
<td>Business Model Change Abstraction model</td>
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<tr>
<td>BMM</td>
<td>Business Model Motivation. A standard by OMG [116]</td>
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<tr>
<td>CEO</td>
<td>Chief Executive Officer</td>
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<tr>
<td>CS</td>
<td>Case Study [141]</td>
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<td>CGM</td>
<td>Conceptual Governance Model, see Figure 6.5</td>
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<tr>
<td>DBM</td>
<td>Digital Business Modeling</td>
</tr>
<tr>
<td>DF</td>
<td>Designed Business Flexibility</td>
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<tr>
<td>DoV</td>
<td>Direction of Value</td>
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<tr>
<td>DRM</td>
<td>Design Research methodology [16]</td>
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<tr>
<td>EC</td>
<td>Exclusion Criteria</td>
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<tr>
<td>EP</td>
<td>Extraction Property</td>
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<td>EV</td>
<td>Execution View</td>
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<tr>
<td>E&amp;E</td>
<td>Effectiveness and Efficiency</td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>GSM</td>
<td>Global System for Mobile communications, Second generation of mobile telecommunication standard</td>
</tr>
<tr>
<td>Hx</td>
<td>Hypothesis x</td>
</tr>
<tr>
<td>IC</td>
<td>Inclusion Criteria</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IoT</td>
<td>Internet of Things</td>
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<tr>
<td>IPSS</td>
<td>Industrial Product-Service Systems</td>
</tr>
<tr>
<td>IS</td>
<td>Information System</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>IV</td>
<td>Interaction View</td>
</tr>
<tr>
<td>IVH</td>
<td>Internally, Vertically, and Horizontally</td>
</tr>
<tr>
<td>LOD</td>
<td>Learning Organization Design</td>
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<tr>
<td>LV</td>
<td>Learning View</td>
</tr>
<tr>
<td>OL</td>
<td>Organizational Learning</td>
</tr>
<tr>
<td>P₀</td>
<td>Abstract collection of processes used for Define (Planning)</td>
</tr>
<tr>
<td>P₁</td>
<td>Abstract collection of processes used for Execute (Operations)</td>
</tr>
<tr>
<td>P+BC</td>
<td>Purpose + Benefit and Challenge</td>
</tr>
<tr>
<td>PGR</td>
<td>Process-level use cases, Goals, and Rules</td>
</tr>
<tr>
<td>PSS</td>
<td>Product-Service Systems</td>
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<tr>
<td>OOAD</td>
<td>Observe, Orient, Decide, Act : OOAD-loop [20]</td>
</tr>
<tr>
<td>RE</td>
<td>Requirement Engineering</td>
</tr>
<tr>
<td>RM</td>
<td>Resource Management</td>
</tr>
<tr>
<td>RQ</td>
<td>Research Question</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>SD</td>
<td>System Dynamics</td>
</tr>
<tr>
<td>SE</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>SECI</td>
<td>Model for knowledge creation via Socialization, externalization, combination, and internalization [112]</td>
</tr>
<tr>
<td>SIPD</td>
<td>Software-intensive Product Development</td>
</tr>
<tr>
<td>SLR</td>
<td>Systematic Literature Review [83]</td>
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<tr>
<td>SPL</td>
<td>Software Product Line</td>
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<tr>
<td>SS</td>
<td>Search string</td>
</tr>
<tr>
<td>SVM</td>
<td>Software Value Map [80]</td>
</tr>
<tr>
<td>TA</td>
<td>Thematic Analysis [30]</td>
</tr>
<tr>
<td>TCA</td>
<td>Transformation of Capabilities into more efficient Abilities</td>
</tr>
<tr>
<td>TCAP</td>
<td>Transformation of Capabilities Abilities recursive, bottom-up Process</td>
</tr>
<tr>
<td>TOGAF</td>
<td>An Enterprise Architecture methodology and framework standard by OMG, <a href="https://www.opengroup.org/togaf">https://www.opengroup.org/togaf</a></td>
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<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>VaM</td>
<td>Value Membrane, see Figure 9.1</td>
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<tr>
<td>VDML</td>
<td>Value Delivery Metamodel standard [115]</td>
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<tr>
<td>VN</td>
<td>Value Network</td>
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Chapter 1

Introduction

Digitalization initiates and drives significant changes to the process level, organization level, and business level of software-intensive product development (SIPD) companies and their customers [125]. Digitalization creates new opportunities through digital transformation strategies [103] of the business environment [14, 103, 91]. Digitalization also significantly reduces the turnaround-time on a transaction, often by several orders of magnitude [125]. As a consequence, the increased transaction speed drives new challenges for the alignment of business and technology changes.

The reduced turnaround-time for business transactions requires a SIPD company to look at existing solutions with fresh eyes on risks and opportunities. To quote Robinson, “it is the unanticipated consequences of choices, sometimes in sectors quite distant from the immediate first order effects, which may provide a basis for views to change” [135]. What previously took days to complete, demanding a multitude of roles involved in dealing with user questions, potential issues, and errors during the transaction, can today be automated by Information and Communication Technology (ICT) systems and performed significantly faster. As a result, the transaction cost can significantly be reduced, and new user groups can start to use these types of transactions as part of their operations, gradually and radically transforming the whole society from both personal and working life perspectives, e.g., travelling, internet banking, grocery shopping, education, journalism etc.\(^1\)

ICT systems have significantly changed how SIPD organizations interact with

the world, making many roles obsolete while in collaboration, creating entirely new types of jobs with new set of risks as well as requirements for new software functionality[14, 103, 91, 119, 138]. As an example, with 5G technology, the industry 4.0\(^2\) will fundamentally change the opportunities and risks involved in running a business\(^3\). In this on-going business and technology transformation, I see business modeling and software engineering struggling to keep up with the pace of change induced from the complexity of a digitally-connected world\(^4\). I dare to say that the digitalization is this century’s business and management paradigm shift, and that humanity currently still reside in the ‘Stone Age of the IT age’ [88]. I refer to this evolution as the transformation of capabilities into more efficient abilities (TCA) with the organization in focus, rather than the business model. Advances in technology trigger TCA, making new types of business feasible [69, 156] in an ever-faster spiral. The increasing business complexity, the speed of change, and the alignment of business and technology are at the core of the problem addressed in this thesis.

SIPD companies are undergoing significant transformations and are struggling with the alignment of business and technology changes [155, 42, 91, 160] to find a lucrative mix between products and services while remaining agile, effective and efficient [133, 107]. Business model alignment has been pointed out as the next key area to overcome these challenges and for moving business model research forward [134]. More specifically, I investigate the management problem of how to manage effective and efficient business model change at a large scale, enabling business model innovation without interrupting the value creation. The management responsibility lies in achieving and maintaining organizational effectiveness and efficiency, by analyzing and setting the strategic direction [43]. Setting the strategic direction implies a continuously change to the business intents [153] while making tactical and strategic choices and business-aware compromises [29]. To minimize misalignments, the organization consistently, and continually needs to evaluate and transform strategies into value-creating transactions, and tune for efficiency via operational feedback, and control systems.

This thesis presents a foundation towards effective and efficient handling of business model change (BMCh). The thesis also includes the reasoning why this topic is a significant contribution to the industry and the literature. This thesis focuses on how a (SIPD) company can keep up with the pace of change in business

\(^2\) A current trend in manufacturing technologies based on Cyber Physical systems, automation, and data exchange, see Wikipedia https://en.wikipedia.org/wiki/Industry_4.0


and technology fueled by digitalization [103, 24]. I argue, that a SIPD company may better utilize the opportunities presented by the digitalization by: (1) approaching every contract negotiation with a customer as a potential BMCh; (2) developing new (software) mechanisms and software architectures for governance and monitoring the effectiveness and efficiency of such BMCh; and (3) become a permanent learning laboratory.

The organization’s challenges discussed in this thesis can be divided into five sub-areas:

1. Observe, i.e., understanding how the SIPD company’s effectiveness and efficiency are related to planning, operationalizing, and executing a business model (or multi-business models), while observing the operational effects in the interactions with the business ecosystem, the learning organization, the customer and partner relationships, and level of innovation in the products and offerings.

2. Orient, i.e., based on events, adjusting the strategies by identifying the sources of misalignment between the strategy and the execution of the strategy through knowledge of, and measurements in the organization’s operational processes and activities.

3. Decide, i.e., invoking the best choices based on active risk mitigation derived from the levels of misalignment in the operations.

4. Act, i.e., making these measurements actionable and aligned with all the strategies for a learning organization.

5. Learn, i.e., creating both individual and collective skills while translating tacit knowledge into explicit knowledge, available to the collective (organization, partners, and customers).

A significant increase in complexity comes from scaling the basic interaction between Party A and Party B into hundreds of actors in an organization or the ecosystem [153].

---

5Inspired from the OODA-loop by John Boyd, Conversation theory by Gordon Pask, and "The Knowledge-Creating Company" by Nonanka et. al., and illustrated in Figure 3.2, detailed in [153], in Section 3.5, and in Chapter 9.
1.1 Aim and research questions

Summarized during 2007-2014 from the Ericsson AB’s interactions with other SIPD companies and leading industry forums and their standards (e.g., TOGAF\textsuperscript{6}, BMM\textsuperscript{[116]}, TM Forum\textsuperscript{7}), the following statements formed the requirements from Ericsson AB on my research.

1. By using state-of-the-art business modeling, we seek to achieve:
   (1) a better predictability;
   (2) be better at knowing their customer’s needs;
   (3) developing generic products to fit more customers;
   (4) leverage scale for multi-business models; and
   (5) to structure our management systems for better internal control and faster feedback.

2. The complexity of the above sought-for abilities is increasing with:
   (1) the frequency of change;
   (2) the increasing amount of stakeholders involved in the value chain, and
   (3) how the delivery of services is becoming digitized and interconnected.

3. To develop, innovate, and optimize the multi-business model operations, we need a systematic approach to evaluating our business management system, to overcome the hurdle of the ever decreasing time to analysis, visualize consequences, and make informed decisions.

The aim for this licentiate, based on the identified research gap and Ericsson’s initial requirements, was formulated as:

*How can a SIPD company avoid the increased complexity to affect the effectiveness and efficiency when fulfilling the company’s strategies?*

I first formulated a research question to understand if and how business modeling affect a SIPD company’s effectiveness and efficiency. Given the influence of the digitalization, I looked for evidence in the literature to support a casual hypothesis indicating there is a positive relationship between the practice of business modeling and the effectiveness and efficiency of a SIPD company.

**RQ1**: How does business modeling (BM) increase the effectiveness and efficiency (E&E) of SPID companies?

---

\textsuperscript{6}An Enterprise Architecture methodology and framework standard by OMG, https://www.opengroup.org/togaf

\textsuperscript{7}A global industry association that drives collaboration and collective problem-solving to maximize the business success of communication and digital service providers and their ecosystem of suppliers, https://www.tmforum.org/
Chapter 1. Introduction

Hypothesis H1: Using BM increases the effectiveness and efficiency (E&E) of SPID companies.

Given the result of RQ1 and H1, I then synthesize the results and prepare for future studies into how E&E can be controlled by management during BMCh, by posting a second research question:

RQ2: What mechanisms affect the E&E of business model change (BMCh), and how can they be tested?

The synthesis of RQ1 and RQ2 cannot provide the needed answers to start designing the artifacts required to construct mechanisms for management (i.e., constructs, capabilities and practices based on software or organizational implementations) to control the E&E during a BMCh, but it will help to develop conceptual models which can be used to further elaborate on RQ2. Figure 3.1 illustrates how the different RQs relate to the different papers and the chosen research methodology, and is further detailed in Section 3 and Section 4.

1.2 Outline

The remaining chapters are organized as follows. In Chapter 2 we present key terminology to understand the context of our research problem and associated industry opportunities and challenges. The research methodology is presented in Chapter 3, followed by a summary of each paper, results, and limitations in Chapter 4. Finally, in Chapter 5, the answer to, and conclusion of the thesis RQs and future research are presented.
Chapter 2

Background

The essential terms used in this thesis are; choice, misalignment, value, effectiveness and efficiency, business model, flexibility, learning organization, and governance. Rooted in conversation theory [126], Promise Theory [12], and Knowledge creation theory [112], each term is examined from two distinct views, planning (define=top-down) and the realization (execute=bottom-up), as proposed by Cavalcante in his investigation of the 'abstract' and the 'performative' levels of BMCh [32] and from our earlier work on business intents [153].

Figure 2.1 illustrates the organization’s challenge of translating their wanted position (To-Be) into strategies and tactics, based on identifying the choices they have (scenarios based on As-Is and a series of Next-Step transformations). There are several available practices for such business strategy making, and the figure illustrates the backcasting with learning method[135] as one example. Backcasting is, in some sense the opposite of forecasting (predicting the future), and means that you assume the position of the wanted position (in the future), and by looking back, identify and decide what actions must be taken (and when) to actually get to this future position.

Figure 2.1 also illustrates the temporal impact of the digitalization and the need for a learning organization. In today’s fast-changing and collaborative business environment[138], the turn-around time (Δt) is shrinking fast between the activities of business strategy making, operationalizing the strategies, and the (daily) operations, forcing multiple change-actions to be overlapping and running in parallel [153]. If the overlaps are not managed explicitly, they are likely to result in new sources of misalignment through increased uncertainty and equivocally [55]. Such a scenario is validated in Chapter 9. I argue that using explicit Next-
Figure 2.1: Towards effective and efficient business model change in a digital business ecosystem.

step(s) connected to the business model, is an essential factor towards controlling the overlapping change-actions, and thereby efficient and effective BMCh. Also, I further argue the importance of using a 3-layered description model maintaining a separation of concerns for scenarios, strategies, goals, and policies (which all exist on each layer), see Section 9.2.4.

### 2.1 Sources of choice

Seen from a business point of view, the highest level of choice available to a company is to detail and present its vision. As a consequence of that vision and as affected by important influencers (e.g., owners, legal, strategic partners, competitors, etc.), the company starts to develop strategies and tactics to reach the vision’s To-Be state. I use the language established in the standard Business Model Motivation (BMM) [116]. For more details, see Chapter 9.

Also, the difference between a vision, strategy, and tactic is mainly temporal and relative, and can only be judged if put together in one context. A tactic presents available, residual choices, derived on the choices that make up the strategy,
often stated in explicit temporal perspectives. I illustrate with some examples of sources:

- **Vision** = the ultimate end-state (and driver for the business).
- **Goal** = a balance of Effectiveness and Efficiency choices.
- **Strategy** = 'strategic' mix of ends and capabilities choices.
- **Tactics** = 'operative' mix of ends and capabilities choices.
- **Activities** = means with abilities in utilizing resources, e.g., where choices can be hard-coded into software products, through mass customization on a template basis, or chosen in run-time by users.

### 2.2 Details of a choice

Using BMM terminology, a choice can always be expressed as a policy and evaluated as a rule [116]. For this thesis, we summarize the important characteristics below:

- **Type of choice**: strategic; tactical; operational; business options; and task and configuration options.
- **State of choice** = Yes, No, Don’t know, Don’t care
- **Right-time-binding** = optimal time to ”lock a choice”, as a balance of value, cost & changeability, see Chapter 7 and [152].

Changeability can be seen as the ability of an organization to offer and execute a choice. Changeability is defined by options under internal ('robustness' and 'adaptability') respectively external control ('flexibility' and 'agility') [133].

### 2.3 Sources of misalignment

A value flow visualizes how a company together with partners and customers create customer value in small steps [115]. An organization implements a value flow using business processes and the levels of ability in performing the underlying tasks. Also, in a digitally-connected world, a value flow is often unique to a specific customer requiring a high degree of flexibility. Misalignment gradually develops from gaps between the value flow steps. There are three significant reasons for these gaps: (1) a misunderstanding of the customer need; (2) the
organization takes a deliberate investment decision (yes or no); and (3) the organization fails in implementing the investment decision.

In most cases, the underlying issue creating these gaps, is the organization’s level of misunderstanding and uncertainty [55] and their ability to organizational learning [42], since lack of organizational learning leads to poor decision-making. Introducing a three-layered business architecture (business, capabilities, realization) helps to provide useful and efficient context-aware descriptions for each stakeholder see Chapter 9. Typical outcomes (and consequences) of poor decisions are manual work needed (slow and costly), errors (rework, lost of trust), lost traceability (increased risks of consequences), and degenerated value creation (customer churn, loss of brand value, penalties, declining sales).

2.4 Understanding value in context

Value creation is the central concept associated with business models [57, 92]. According to Lepak et al., value creation is divided into 'use value' (as perceived by an individual) and 'exchange value' (as the monetary compensation) and should be related to the source and the target on different levels (individual, organization, and society). As such, value creation is highly subjective and context-specific, and almost every research field have their own taxonomy of "values", see examples in [80], and more details in section 6.2.4, section 9.2.2, and Figure 9.1.

In this thesis I connect value to the outcome of an interaction between two actors. I classify value into Intended Value, Anticipated Value, and Perceived Value, see Figure 8.2.

2.5 Effectiveness and efficiency at scale

Effectiveness and Efficiency at scale can in simple terms be summarized as generating value from doing the right 'thing', and doing the 'thing' right. The term Effectiveness is defined\(^1\) as “the power to produce the desired result” and Efficiency is defined as “the ability to do something or produce something without wasting materials, time, or energy: the quality or degree of being efficient (technical)”, but also as “the power to produce the desired result” causing some ambiguity

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\(^1\)See Webster-Meriam dictionary,
https://www.merriam-webster.com/dictionary/effectiveness
https://www.merriam-webster.com/dictionary/efficiency
Chapter 2. Background

between the two terms. Buder et al. differentiate between quality (effectiveness) and required effort (efficiency) [25]. Organizational effectiveness is discussed by Zheng et al. in combination with strategy and knowledge management, where they use the definition “the degree to which an organization realizes its goals” [172].

I use effectiveness as the combination of Webster-Meriam dictionary, Buder et al. and Zheng et al. with quality as a value-based concept to detail the 'desired result.' With efficiency, I mean “the ability to do something or produce something without wasting materials, time, or energy”.

2.6 Business model and business model change

Among the various definitions, interpretations, and usage of the business model concept (e.g., [121, 46, 51, 158, 8, 147, 72]), a consensus is growing for that value, organization, business logic, and activities are the core parameters of a business model [134, 177]. Fjeldstad & Snow further highlight organization design and collaborative forms while arguing value configurations as the pivotal element of the business model. They conclude, that only by making research findings more interpretable and actionable, managers could benefit from creating and maintaining business models [57].

I use Höflinger’s definition “A business model is the design of organizational structures for converting technological potentials into economically valuable outputs by exploiting business opportunities.” [72]. Many scholars have identified the gap between planning, operationalization, and execution of the business model [105]. To analyze the gap between planning and execution whilst maintaining a focus on value creation and capture, we complement Höflinger’s top-down definition of the business model with Rohrbeck et al. bottom-up definition of business modeling, “to be a creative and inventive activity that involves experimenting with content, structure, and governance of transactions that are designed to create and capture value” [137] derived from Zott et al. view of a business model discussing how the level of aggregation (of activities) affects the ability to create and capture value, especially with the advances in IT to balance of speed and cost in the planning and the realization [175].

BMCh always requires the two phases of (cognitive) planning and execution (in a realization) [32]. Therefore, performing effective and efficient BMCh, implies both the aspects of business strategy making and how these different choices (strategic, tactic, operational, and the variability in products) are transformed by the organization into the company’s abilities in the daily, value-creating activities.
These two phases involve activities for:

1. changing strategies and plans (planning).
2. transforming required capabilities into efficient abilities (execution).
3. governance via control mechanisms based on feedback and feed-forward loops between the two phases.
4. learning, transforming individual tacit knowledge into explicit knowledge, available to the organization.

### 2.7 Business flexibility

Flexibility is “is the ability to adapt when confronted with new circumstances...and provides the organization with the ability to change to adapt to change and respond quickly to market forces and uncertainty in the environment.” [97]. Lucas & Olson also argue the flexibility paradox where IT can both increase and decrease an organization’s flexibility.

Flexibility is very context-dependent concept, and almost every research field have their own taxonomy of "flexibility-types", see more details in section 7.2, section 7.4.2, section 9.2.3, and Figure 9.1.

I define Business Flexibility (BF), as the “negotiable options in: (1) Relationship; (2) Financial; and (3) the Value proposition between two parties trying to reach an agreement”\(^2\). These options are needed for an effective negotiation to leverage a SIPD company’s ability to compromise without breaking the promise in the final contractual agreement.

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\(^2\)The terms Relationship, Financial, and Value proposition refer to the context of Osterwalder’s right side of the BMC [118].
Chapter 3

Research methodology

This section presents the research methodology used to answer the research questions posed in Section 1.1, with an overview illustrated in Figure 3.1.

3.1 Research design

The research design is tightly connected to the research problem [54]. This thesis uses software and software development as the lens for investigating how organizations should respond and transform in response to digitalization. For the merits of qualitative, cross-disciplinary (technology and social), and empirical-based research, this thesis is based on research methods for software engineering [65, 166].

According to Wohlin et al., two main design approaches exist in software engineering research. The quantitative research design uses a fixed design before the collection of data, while in the qualitative paradigm, the design evolves during the research process as the data collection and analysis are intertwined [166].

The research in this thesis uses the qualitative paradigm focusing on non-numerical data to seek explanation and causes of a phenomenon. The design is further classified into research strategies discussed in the next section.

However, the issue at hand in this thesis is not only related to empirical evidence of the effectiveness and efficiency of products and related processes but also about real-world change while adapting people and organizations to the macro- and micro-levels of the business ecosystem. Therefore, to illustrate how
Figure 3.1: RQs mapped on used methodology and papers including paper contributions to this thesis.
my design evolved, I add the iterative research stages proposed in the Design Research methodology (DRM) [16] to complement the qualitative paradigm and to illustrate the evolution of the thesis initial design strategy. DRM is based on four study stages, as a means to facilitate dissemination of each paper’s contribution towards the appropriate stakeholders, and the overall aim of this thesis to present an explanation including propositions for next step. See Table 3.1 and Figure 3.1 for a quick overview of DRM applied to this thesis.

Table 3.1: Design Research methodology (DRM) applied on this thesis.

<table>
<thead>
<tr>
<th>Study stage</th>
<th>Paper</th>
<th>Means</th>
<th>Main outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research clarification</td>
<td>PAPER 1</td>
<td>Literature review, exploratory interviews</td>
<td>Goals, research direction</td>
</tr>
<tr>
<td>Descriptive study I</td>
<td>PAPER 1+2</td>
<td>Interviews, Documentation Analysis, Thematic analysis</td>
<td>Understanding of the current situation</td>
</tr>
<tr>
<td>Prescriptive study I</td>
<td>PAPER 3+4</td>
<td>Synthesis, Conceptual Modeling</td>
<td>Explanation of conceptual models, Propositions to management</td>
</tr>
<tr>
<td>Descriptive study II</td>
<td>PAPER 4</td>
<td>Interviews, Focus Groups, Empirical data analysis</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

3.2 Research strategies used

In this thesis, a Case study research strategy (CS) has been used embedding a Systematic literature review strategy, since the research questions are exploratory knowledge questions [54] and evolved during the data collection and analysis.

Case Study (CS)

According to Yin, the CS strategy is used to collect and analyze qualitative data fairly to understand complex social phenomena, especially if the boundaries between phenomena and context are not clearly evident. The more the research questions seek to explain a phenomenon (e.g., how or why?) or require an extensive "in-depth" description of the phenomena, a case study is a good methodology choice [168]. The ability to understand the complexity of the analysed problem rather than abstracting from it, is a principal advantage of performing qualitative CS [150]. The CS is seen as a flexible research strategy, since the details of the design tends to "emerge" during the data collection and analysis [141]. The CS is both quantitative and qualitative [166]. The CS is characterized by its' unit of analysis in relation to context, i.e., single-case vs. multiple-case designs, and
single-unit of analysis (holistic) vs. multiple units of analysis (embedded). This thesis uses holistic single-case design, matching two types of cases (critical and longitudinal) [168].

**Systematic literature review (SLR)**

This (sub-)strategy is used to collect the state-of-art within a specific area and "is a means of evaluating and interpreting all available research relevant to a particular research question, topic area, or phenomenon of interest. Systematic reviews aim to present a fair evaluation of a research topic by using a trustworthy, rigorous, and auditable methodology." [83]. An SLR is often embedded as an integral part of other research strategies.

The SLR in this thesis is based on the guidelines for snowballing literature search proposed by Wohlin [165]. The snowballing methodology is considered less noisy in cross-disciplinary research compared to a similar database-search based methodology due to its inherent adaption to a specific area’s terminology (by following references and citations).

### 3.3 Data collection methods

Selecting proper data collection methods is important and critical. What data to collect might not be all clear when defining the objectives of the research. As the research progress, more sources become available and insight on what sources are needed evolves. This progress illustrates why a flexible design is favorable for a CS. It is also good to use multiple data collection methods and data sources to overcome the limitations of single techniques, to triangulate and learn about different aspects of a phenomenon. [141, 54, 93].

Using the taxonomy presented by Lethbridge et al. [54, 93] this thesis used first degree, inquisitive techniques in Interviews and Focus Groups, plus a third degree technique of documentation analysis. In addition, thematic analysis (TA) was also used.

**Interviews**

Interviews are often the primary data collection method and a central data source for CS. A lot of information can be collected from written material, but to also understand the aspects of quality, whether methods and results were used, etc.,
Chapter 3. Research methodology

the interview plays an important data source for CS. An interview is normally conducted with one individual at the time to avoid any bias from other parties. There are three interview types and the objective with the unstructured interview type, is used to explore how individuals qualitatively experience the phenomena by using an interview guide with open questions. The semi-structured interview type adds the quantitative aspect by using open and closed questions. At the other end of the spectra, the fully structured interview type only focus on closed questions to identify relationships between constructs. An interview is normally conducted in three phases: planning, interviewing, and post-interview activities such as follow-up with the interviewee enabling them to clarify, correct, and even expand on the topic. This last phase is important to create trust [141].

In this thesis, I performed unstructured and semi-structured interviews.

Focus Groups

Focus Groups is also common in CS, and differ from interviews in that a group of individuals, in one session, participate in an interview type of setting. Except for the apparent advantage of cost-efficiency sessions, other positive effects are, e.g., discovery of new insights in the group, discovery of new insights, more in-depth discussions with more expertise in the group, the participants also benefit from networking and learning from each other. Especially if the participants come from different organizations or even companies. Examples of weaknesses are trust issues preventing ”free speech”, a session might be hard to moderate due to individual agendas, and a limited amount of topics that can be addressed [141].

In this thesis, I used Focus Groups extensively as performed by me, a moderator, and a secretary or modeler with a full focus on documenting the discussions.

Documentation Analysis

I adopt the argumentation forwarded by Runeson et al. that documentation analysis can be used on both documentation and archival data (e.g., minutes of meetings, technical documents, and reports) with the borderline between qualitative and quantitative data instead[141]. As a third degree data collection method, it is important to remember that the document was initially produced with a different purpose than the research topic, and therefore it may be hard to extract relevant information for the research topic, as well as to judge the
quality of the extracted data. I also add scientific articles into the category of documentation.

Therefore, I performed an extensive documentation analysis in this thesis.

**Thematic Analysis**

Thematic analysis is a data analysis strategy, focusing on “a method of “identifying, analyzing, and reporting patterns (themes) within data” [30, 22]. Generally, TA can be divided into five steps:

1. compiling, i.e., to organize the data into useful forms.
2. disassembling, i.e., to separate and create meaningful groupings, often using coding.
3. reassembling, i.e., all codes are put into context to create themes, as related to important concepts related to the RQs.
4. interpreting, is a critical step making the analytical conclusions.
5. concluding, i.e., by presenting the response to the research questions or purpose of the study.

In this thesis, I used Atlas.Ti\(^1\) as the tool for the first three steps. In step 4, I involved my colleagues in discussions while documenting our findings in my conceptual models.

### 3.4 Validity

An important part of good research design is to openly report on different validity issues and what countermeasures have been taken to minimize researcher bias. In this thesis we adopt the terminology used by Runeson et al.[141]:

- Construct validity discusses potential misalignment between what the researcher wants to study and what is investigated according to the RQs.
- Internal validity is especially important for casual relations, but also in cross-disciplinary research. Does the researcher know of all factors related

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\(^1\)Atlas.ti is a system for conducting grounded theory analysis of texts and voice recordings. In this tool you can mark text and apply codes, and you can generate different views (e.g. a network view, where different relationships between papers can be investigated.) of your analysis. [http://atlasti.com](http://atlasti.com)
Chapter 3. Research methodology

to the investigated factor? Especially in cross-disciplinary research, special efforts should be made to identify all significant factors.

- **External validity** is a factor related to what extent generalization of the findings is possible. Also, it indicates to what extent the findings can be attractive to people outside the area.

- **Reliability** revolves around how much the data and analysis are dependent on the specific researcher, e.g. if it is not clear how data was coded or which interview questions were used.

There are a number of techniques to improve validity listed in literature, e.g., [141, 136] and I list the ones applied in this thesis:

- **Prolonged involvement**, implies conditions where there is time to build trust between researchers and the organization.

- **Triangulation**, using multiple sources or persons performing specific research activities (e.g., collecting, coding).

- **Peer Debriefing**, discussing the CS with peer researchers and experts

- **Member checking**, let participants review the material.

- **Negative case**, improving the analysis by formulating alternative explanations.

- **Audit trail**, keeping a systematic track of all data and material.

Also, for research performed in industrial settings, an additional set of challenges can emerge [54]:

1. what practitioners say is not necessarily neither what he/she means, nor what is needed or required by the organization. To find accurate data can be hard.

2. data quality can also be low

3. observing may change the behavior of observed persons

4. obtaining permission to publish results (e.g., confidential data or insights).

Sponsored by industry while doing my licentiate, I feel confident with the industrial setting of this thesis, given high attention to validity issues. Please see Chapter 4 for details per paper.
3.5 Research classification

This section presents a paper-centric description of Figure 3.1 and Figure 3.2, summarizing the critical elements of the research design, i.e., challenges, RQs, stages of DRM, research strategy, and data collection methods.

Figure 3.2 illustrates how the appended papers relate to the organizational challenges introduced in Section 1. PAPER 1 analyzes the business model from the OOAD perspectives. PAPER 2 looks into flexibility as a means for how the speed is affected by the relationships between the OOAD perspectives. PAPER 3 discusses how the value creation in a transaction shapes goals and strategies related to a business model while PAPER 4, with an organizational focus, investigates the relationship between a learning organization and how to perform effective and efficient business model change.

**Figure 3.2: Organizational challenges mapped to appended papers.**

**PAPER 1 and PAPER 2**

Due to the cross-disciplinary goal of this thesis, PAPER 1 and PAPER 2 is based on the SLR strategy. PAPER 1 started with the Research clarification stage using exploratory Interviews, CS, SLR, and TA. PAPER 2 evolved the SLR into a Descriptive Study I, based on PAPER 1, SLR, and TA. PAPER 1 and PAPER 2
use an SLR strategy based on the snowballing methodology proposed by Wohlin et al. [165].

The need for a literature review became apparent from the initial discussion and clarification with Ericsson of the goal for my research. During a pilot study, I: (1) interviewed experts in multiple fields; (2) refined the search strings; (3) specified a study selection approach; (4) developed a search strategy; (5) defined study quality assessment; (6) defined a data extraction process; and (7) created the review protocol.

Since the research problem span a wider area than software engineering and computer science, SCOPUS was selected as the primary source, with subsequent additional searches in ACM, IEEE Xplorer, Inspec Compendex, Science Direct, and ISI/Web of science. Nine different subject areas were investigated: Multidisciplinary, Economics, Environmental Science, Social Sciences, Psychology, Engineering, Business, Decision Sciences, and Computer Science.

A combination of spreadsheet\(^2\) and a reference management system\(^3\) were used to import the papers and keep track of the review selection progress, including a first full-text reading. The final list of selected papers were then imported to a tool named Atlas.ti\(^4\) supporting TA. With the help of Atlas.ti, the coding was done as an iterative process. I applied open coding to each of the first ten papers. Selective coding was done on all the other selected papers. With the help of memos I created the first iteration of the extraction table. This process continues until all papers were read. The papers from the former sets were included in new iterations. A coding and re-coding was applied on papers when the understanding of the content gradually improved. The theoretical codes were supported by using network views (a feature in Atlas.ti). The network views based on codes were used to find the relation between the papers. The extracted data were analyzed and synthesized based on the memo concept in grounded theory [35].

PAPER 3

PAPER 3 is part of the Prescriptive Study I, and is a synthesized vision paper based on PAPER 1, PAPER 2, combined with our work with compositional intent-driven systems [153, 152].

\(^3\)Mendeley https://www.mendeley.com
\(^4\)Atlas.ti is a system for conducting grounded theory analysis of texts and voice recordings. In this tool you can mark text and apply codes, and you can generate different views (e.g. a network view, where different relationships between papers can be investigated.) of your analysis. http://atlasti.com
PAPER 4

PAPER 4 is a part of the Prescriptive Study I, but evolves the synthesis further into also becoming an initial part the Descriptive Study II, presenting an initial conceptual model for effective and efficient BMCh. PAPER 4 is a CS based on Runeson et al. [141], and use a holistic, single-case CS design combining a critical and a longitudinally case. For data collection, we use a Focus Group approach for the critical case [94] in order to mimic the information and workflow used in the studied company. Information was captured in documents, drawings, and photos. The data were collected during Focus Group interviews with the appointed persons during 1-3 hour sessions. Additional data was collected from the studied company’s document management system, e.g., monthly reports, architectural descriptions, business process documentation, and detailed service descriptions. Data triangulation was achieved by using interviews, informal meetings, continuous member checking [136].
Chapter 4

Summary of appended papers

Figure 2.1 illustrates the context for RQ1 and RQ2 as posed in Chapter 1.1, as all daily choices (strategical, tactical, and operational) and decisions a SIPD company faces in their digital transformation (from As-Is via Next-Steps towards the To-Be) while maintaining the effectiveness and efficiency in the value-creating business interactions with partners and customers. In Figure 3.1, we also indicate the relationship between our research questions, chosen methodologies, and the different papers including their main results. A more detailed description follows below.

4.1 PAPER 1 - Business modeling requires governance

PAPER 1 is available in Chapter 6. In this paper, we investigated the research gap between business modeling (BM) and effectiveness and efficiency, by exploring RQ1 and answering H1. We performed a systematic literature review with a set of sub-RQs to capture the reported contextual setting:

Extracting quotes of purpose, set the general context, while quotes of challenges or benefits often are reflections of how well a solution to a specific problem works. Benefits refer to a solution with good enough result (but tends to be assumed, rather than validated) while challenges refer to potential issues in obtaining a satisfactory result.
Chapter 4. Summary of appended papers

- RQ1.1 What benefits and challenges of BM are reported in the literature?
- RQ1.2 What effects related to effectiveness and efficiency of BM are reported in the literature?

We used the snowballing methodology for the systematic literature review [165], and the systematic literature review helps us understand the state-of-the-art concerning BM and effectiveness and efficiency of SPID companies. During the systematic literature review, we also extracted available methods and concepts that may be useful for answering RQ2, see Table A.3.1 for the data extraction properties.

4.1.1 Main results

- Related to RQ1.1, the overarching purpose found for BM is for a company to stay competitive and improve its business results. The quotes of purpose are often overlapping and cover a wide variety of more specific topics.

- Most of the quotes on challenges relate to the non-existing solutions for governance (representation, simulation, decision-support, and feedback) of the proposed frameworks and methods. Also, the quotes of benefits are unsubstantiated or claimed with limited empirical evidence.

- We identified three primary contexts for BM (columns in Table A.4.1): (1) Strategy and planning; (2) Daily operations (executing strategies and plans); and (3) Governance and communication.

- Although many scholars assume that business modeling has a positive effect on effectiveness and efficiency, we found no evidence to support the hypothesis H1. It remains an open question whether the application of any of the identified practices results in increased or decreased efficiency or effectiveness for a company’s business. Any outcome variations may simply be a result of fluctuating contextual or environmental factors rather than the application of a business modeling method or technique.

- We synthesize five BM trends and propose four implications on industry and academia.

- We propose a conceptual governance model (CGM) for exploring and evaluating the effectiveness and efficiency of business modeling, see Figure 6.5. The CGM is based on the Define, $P_0$ and Execute, $P_1$ processes with five interfaces to manage the effectiveness and efficiency. The processes $P_0$ and $P_1$ co-exist in all business processes as well as cognitive for each actor, creating a highly complex and recursive inter-dependency.
Chapter 4. Summary of appended papers

- Flexibility and variability in the realization have a strong correlation (=1.0) to papers answering RQ1.2, leading up to the follow-up investigation in Chapter 7.

4.1.2 Main validity issues

Investigating a cross-disciplinary phenomena (mainly Business Management, Computer Science, Work and organizational psychology), semantics becomes problematic and a cause of equivocality when interpreting data. I investigated nine different subject areas with somewhat different semantics depending on the subject area and the problem context. This was addressed by using Snowballing, Peer Debriefing, and Triangulation (by sharing work and using articles from different fields in TA).

To improve internal and construct validity, I also

- took extra measures to find effective search strings with the pilot study and the refinement of the search string, but still, there is always a risk of uncertainty on higher abstraction level, leading to equivocality and the interpretation of the details as an assumed consensus.

- performed the Cohen’s Kappa analysis at three different stages of the SLR reaching coefficient values of $k=0.566$, $k=0.638$, and finally $k=0.763$.

- performed rigor and relevance analysis [75].

- since a lot of information was third-degree data, I applied a rigorous TA involving three peers.

- used Negative case analysis when interpreting the results.

External validity was improved by using Peer review with peers from Business and Management, Economics, Software Engineering, and an expert from industry. Also, my synthesis is based on theories developed outside Software Engineering.

Reliability was addressed by using Audit Trail and reporting of the interview question.
4.2 **PAPER 2 - Flexibility is the key, but how to analyse changeability?**

PAPER 2 is available in Chapter 7. In this paper, I continue to investigate the research gap based on the findings identified in PAPER 1, and using the same systematic literature review. We focused on how BM can support flexible business strategies and address the challenge of efficiently implementing the right flexibility with business options. For SIPD this means deciding on investment levels of variability in the software and the business process implementations. We explore RQ1 with a new set of additional sub-RQs:

- **RQ1.3 What benefits and challenges are associated with flexibility in business modeling?**
- **RQ1.4 What effects of business modeling related to business flexibility and variability in the realization are reported in the literature?**

We use RQ1.3 to investigate the contextual setting for BM and flexibility. RQ1.4 addresses how BM can support flexible business strategies and address the challenge of efficiently implementing the right flexibility in business options, e.g., deciding the right level of variability in realization.

### 4.2.1 Main results

- The quotes of benefits are mostly unsubstantiated or claimed with limited empirical evidence, while the most common challenge for the 13 papers explicitly discussing flexibility is how to deal with the dynamics of business models. We identified the same three primary contexts for flexibility in BM (columns in Table A.4.1): (1) Strategy and planning; (2) Daily operations (executing strategies and plans); and (3) Governance and communication (as in Section 4.1).

- Most of the quotes on challenges relates to the non-existing solutions for governance (representation, simulation, assessment, decision-support, and feedback) of the proposed frameworks and methods. Also, there are significantly more challenges (36) than benefits (8) reported for these 13 papers, indicating that solutions to achieve flexibility are still immature.

- Our identified studies offer only partial approaches and solutions to manage the desired flexibility and to facilitate pivoting in response to disruptive changes in the realization of the business model (e.g., products, organizations, processes, contracts, governance).
• We argue that efficient governance mechanisms focusing on continuously managing consistency and traceability of options, need to be built into both business and software architectures, to contentiously create and manage the required variability in realization.

• We believe the concept of changeability as forwarded by Richter et al.[133], implemented with a governance mechanism between the business and software architectures, can play a pivotal role for the operationalization of flexible business models. Therefore, we propose a framework for describing and documenting change based on changeability aspects and contextual dimensions, see Figure 7.1.

4.2.2 Main validity issues

The same as for PAPER 1, see Section 4.1.2.

4.3 PAPER 3 - Shaping business goals via Interaction and Learning

In PAPER 3, see Chapter 8, I present a vision towards how the business goals are continuously changed based on the (human) experiences received from executing the daily business tasks as a learning organization (interacting with partners and customers). Managing changing business goals is critical when adapting to the changing business environment through business model change. The paper presents a conceptualization for how value is transformed from an interaction view, via a learning view, into the real execution view, see Figure 8.2.

4.3.1 Main results

We argue that the feedback loops must be supported by efficient role-based information management tools that can be efficiently and transparently used by all actors collaborating in the value capture and value creation activities. Given today’s methods in requirement engineering, including goal modeling, the modeling methods and tools are not fast enough to allow all actors to collaborate efficiently to realize the business goals. We propose to develop a scalable information structure as a basic structure to represent business goals. It will hold the context for each actor (in a context frame) using compositional intent-driven
systems maintaining all relationships between choices (strategical, tactical, operational, and the variability of the realization). It will form the base for the different governance views needed to minimize misalignment between business and technology change (aligning the planning with the execution of a business model change).

Also, by discussing the importance of, and separating value in Intended value, Anticipated value, and Perceived value, we lay the foundation for addressing the intricate relationships between the four vital processes for organizational learning (value creation, value capture, knowledge creation, and knowledge management), as presented in Chapter 9.

4.3.2 Main validity issues

Construct validity and internal validity is addressed based on measures taken for PAPER 1 and PAPER 2, see Section 4.1.2. PAPER 3 builds on [153], and I believe the Member checking done in [153] together with additional Peer Debriefing (one industry expert and two colleagues at Ericsson) improved validity.

External Validity measures mainly stem from basing the synthesis on existing theories outside software engineering and the business and management area, and using Peer Debriefing.

4.4 PAPER 4 - Linking value membrane, governance, and learning organization to BMCh

PAPER 4 is presented in Chapter 9 and builds on the PAPERs 1, 2, and 3, synthesizing the impact of digitalization on business model change for the SIPD industry. I link effectiveness and efficiency, to value creation in business model activities and organizational learning, in a step towards conceptualizing business model change as a significant part of developing software architectural support for a business model change in a learning organization. The synthesis is validated in a longitudinal case study at Ericsson.

4.4.1 Main results

I highlight three critical aspects of business modeling in the analysis of the misalignment between planning and execution.
Chapter 4. Summary of appended papers

1. Focus on experimenting [137], as a ‘round-trip’ process of translating an idea into execution, test, evaluate, and change until satisfied’ (similar to the agile method of developing software products followed up by proper retrospectives).

2. Focus on transactions [175], thereby connecting the business model to human behavior and value in execution and planning activities.

3. The analysis of value is direction-sensitive, with minimum two (role-dependent) views of the transaction, implying an information representation suitable for maintaining (observe, analyze, decide, change) many relationships (supporting efficient collaborations through all the stages of the business model lifecycle, e.g., plan, design, deployment, execution, phase out) [153].

Based on the synthesis, I further highlight four critical aspects that SIPD companies need to address, to develop their competitive advantages with sustained operational effectiveness and efficiency, while moving further into the information age:

- Business model innovation for the business ecosystem [138, 137].
- Focused on automation and integration of business and software architecture, information, and tools with products designed for mass-customization in a collaborative agile development [114, 26, 119, 98].
- Improve badly designed organizations, affecting both the product development as well as the value delivery, e.g., agreement structures, incentives, processes, knowledge management and organizational learning, measurements of effectiveness and efficiency, revenues, cost, decision-making based on multifaceted optimization and transparency [88, 77].
- The level of integration and automation between the four processes of value creation, value capture, knowledge creation, and knowledge management [92, 42]. This is the foundation for an innovative enterprise and should be nurtured as a key competitive advantage.

4.4.2 Main validity issues

The construct validity and internal validity measures are based on the measures taken for PAPERs 1 and 2, see Section 4.1.2. Also, specifically for the internal validity, the Prolonged involvement with Ericsson created a trustful environment, with a lot of (confidential) details revealed. The Focus Group sessions involved extensive Member checking. I also had access to top- and middle-management minutes of meetings, meetings, and other documentation.
Chapter 4. Summary of appended papers

External validity and Reliability are both complicated to evaluate due to the industry setting and confidential nature of strategies, data, and measurements.

Also, adding to the broader validity discussion of the thesis, and the fact that the conceptual models and propositions in PAPER 4 have been synthesized from three theories and an extensive set of cross-disciplinary literature, my results have not yet been part of a systematic approach to building a SE theory [154]. However, this is a deliberate decision based on the balance of efforts and available means for this research and the receivers of this research. I believe the results presented in this thesis constitute a solid foundation to kick-off the next step towards effective and efficient BMCh.

I have in this thesis prepared approximately half of the foundation for defining constructs and propositions in the initial steps of building a SE theory. To quote Sjöberg et al. “What is the bulk of data necessary to begin theorizing? When is it neither too early nor too late to begin? Nobody can tell. It all depends on the novelty of the field and on the existence of theoretically-bent scientists prepared to take the risk of advancing theories that may not account for the data or that may succumb at the first onslaught from fresh information gathered in order to test the theories”.

Part of the goal for my research is to build a theory for how effective and efficient BMCh can be achieved through software-based governance mechanisms, and whether these mechanisms are worth the investment in new software and business architectures. I believe I have reached good enough construct and internal validity to take on the future work ahead.
Chapter 5

Conclusions

RQ1 aims at finding evidence in the literature for how business modeling helps maintaining effectiveness and efficiency. The results indicate that many different practices and methods exist, but little proof is found for improved effectiveness and efficiency when evaluating the complete cycle, i.e., designing, operationalizing, and execution of a business model. The hypothesis H1 is falsified, and my literature review confirms that most scholars either focus on detecting or preparing change at one level (strategy, portfolio, or product), or by analyzing the broader aspects of the organization, external environment, and innovation without connecting it to a realization of the business model (products, services, business processes, and organization using efficient tools), see Chapter 6.

On the positive note, business model research has long been scattered and developing in silos, but recently, a consensus is forming that value, organization, business logic, and activities are the core parameters of the business model. The organization is responsible for the effectiveness and efficiency of the business model, therefore accountable for continuously transforming needed capabilities into efficient abilities that create value in daily interactions with customers and partners. I believe such an organization-centric view of business models, will help to address the alignment issues and implementation of effective and efficient business model change, see Chapter 9.

RQ2 seeks to find evidence in the literature of mechanisms that can be used for effective and efficient business model change, and how such mechanisms can be tested. I found many promising concepts such as: digital business strategy; collaborative business modeling; digital business modeling; value capture, value creation and value transformation; strategic and organizational flexibility; change-
ability; equivocality and uncertainty; learning organization; industrial product-service-systems; intent-driven systems; just to highlight a few from Chapter 6 - 9. These concepts were synthesized into the conceptual models presented in this thesis (see Figure 6.5, 7.1, 8.2, 9.1, and 9.2).

However, I did not present any conclusion on how to test such mechanisms, but in the list of future research, I present a way forward to reach that goal. I believe that this thesis represents a significant contribution to both academia and industry with:

1. a governance framework for business models (CGM), see Figure 6.5.
2. a framework for describing and documenting change based on changeability aspects and contextual dimensions, see Figure 7.1.
3. a conceptualization for how value is transformed from an interaction view, via a learning view, into the real execution view, see Figure 8.2 and in this process, changing goals and strategies.
4. linking value membrane, governance, and learning organization to BMCh in a three-layered abstraction level model, see Figure 9.1.
5. establishing four initial governance views for detecting misalignment, based on efficiency (time and resources measuring the physical gap), effectiveness (measuring the value gap), equivocaility, and uncertainty (both measuring a mental gap).
6. a governance mechanism including the value membrane, based on a scalable information construct for describing (and sharing) the context for each role in a transaction. We suggest compositional intent-driven systems as base for an implementation.

The research questions RQ1 and RQ2 support Ericsson in their strategy work for improved multi-business model operations, and how to change accordingly. The results from Chapter 6-9 generate design artifacts and new design problems which make it possible for Ericsson to produce a first proof-of-concept of efficiency during BMCh. Such a proof-of-concept will make it possible for me to answer RQ2 in the future fully.

The thesis is based on a philosophical view of constructivism (also known as interpretivism) [54], as I believe there are just as many views to a problem as there are persons in a room. This understanding leaves room for the known weakness of case studies, where the data collection and analysis are more open to interpretation and researcher bias. It is worth highlighting, even though I believe satisfactory countermeasures have been taken as reported in this thesis.
5.1 Limitations

The cross-disciplinary aspects of the studied phenomena would need special attention going further by involving researchers from the respective discipline in close collaboration. Such collaboration would help reducing equivocality due to personal bias, but more importantly, add details to the relationships between the different proposed conceptual models and the future theory constructs.

5.2 Recommendations for industry

I propose industry to build knowledge and experience around the following concepts and propositions, to develop their competitive advantages, maintaining operational effectiveness and efficiency, while moving further into the information age:

- Business model innovation for the business ecosystem, e.g., driven by markets and contextual changes, co-creation of value, collaboration within and between organizations, partners, communities, and customers, new streams of revenue while sharing of risks, revenues, and costs [138, 137] (see section 6.2.3, 6.2.4, and 9.5).
- A digital SIPD, focused on automation and integration of business and software architecture, information, and tools. Products designed for mass-customization in a collaborative agile development, can sustain the speed of change and increasing demand of customer experiences (delivered as cloud services) [114, 26, 119, 98] (see section 6.2.4, Chapter 7, and Chapter 9).
- Badly designed organizations, ill-suited for experimentation and collaboration in a digital business world, affecting both the product development as well as the value delivery, e.g., agreement structures, incentives, processes, knowledge management and organizational learning, measurements of effectiveness and efficiency, revenues, cost, decision-making based on multifaceted optimization and transparency [88, 77] (see Chapter 9).
- The level of integration and automation between the four processes of value creation, value capture, knowledge creation, and knowledge management [92, 42]. This is the foundation for an innovative enterprise and should be nurtured as a key competitive advantage (see Chapter 9).

Below propositions are further detailed in Chapter 9.

**Proposition 1:** A mechanism for early-detection of business model change is
a critical factor in maintaining a company’s negotiating power to ensure business success, via improved risk management derived from the business flexibility.

**Proposition 2:** A governance mechanism including VaM, needs to be based on a scalable information construct for describing (and sharing) the context for each role in a transaction. This can reduce both equivocality and uncertainty, and thereby minimizing potential misalignment.

**Proposition 3:** Value translation and value transformation capabilities are essential for BM. By exploring value, in an interaction on the individual level as the unit of analysis, we can resolve ambiguities in relation to the different areas of the business model (e.g., product offering, product delivery, product development, finance, customer relationships, partner management) stemming from: (1) the direction of value; (2) inter-level relationships of source and target for value; and (3) aggregation issues for value creation and value capture (scalability and value slippage).

**Proposition 4:** SIPD companies possess a unique advantage for detecting and implementing BMCh. By using their software development process to integrate their business model innovation with their product innovation, they can efficiently develop ‘native’ product support for managing the linkage of contractual flexibility to the configuration of software products, to achieve richer levels of business model experimentation and collaborative business modeling.

**Proposition 5:** SIPD companies have a unique opportunity for implementing business flexibility and efficiently creating value propositions. SIPD companies should develop software architectures and software functionality to enable a synchronized change in their business model and products using BM.

**Proposition 6:** Given our 3-layer BMCh AM ‘Business layer’, ‘Capability layer’, and ‘Realization layer’, we can conceptualize BMCh as ‘a gap between BF, efficiency, and value’.

**Proposition 7:** The practice of Digital Business Modeling (DBM) should be coined as a fusion between current practices of business modeling and requirement engineering, and become an essential practice in a Learning Organization Design to facilitate business model innovation through experimentation.
Chapter 5. Conclusions

5.3 Recommendation for a cross-disciplinary research agenda

I recommend the following topics to be added to a cross-disciplinary agenda for business models:

- Further exploring how contextual information in the business model construct could be systematically represented, structured, and stored. The improved representation of contextual information can increase effectiveness and efficiency when creating, modifying, and deleting information needed to transform strategies into tactics and daily execution, e.g., facilitating business model choices (see Chapter 6). A business model construct should support collaborative and role-based interaction, including exchange and interpretation of contextual information, scalable to thousands of actors, and across corporate borders (see Chapter 8).

- Connecting the business modeling practice with Learning Theory would help to create conceptual models to explain (see Chapter 6, 8, and 9):
  (1) how value creation and stakeholder motivation is derived from, and connected to, daily interactions;
  (2) how daily interactions, in combination with organizational learning, shape the transformation of strategy into execution; and
  (3) how organizational learning influences the process of business modeling. These aspects become increasingly important since experimentation with value co-creation and business models are gaining interests.

- Adding Business Model Change as an extension to Ritter & Lettl’s business model research framework and its’ business model alignment[134], researchers may address many of the identified cross-disciplinary challenges, and as indicated by Legner et al. “digital transformation requires a focus on the business solution first..., the foundations for the technological system background should be laid, rather than vice versa” [91] (see Chapter 9).

5.4 Future work

The goal for my research is to build a theory for how effective and efficient BMCh can be achieved through software-based governance mechanisms, and have that theory validated by industry to see whether these mechanisms are worth the investment in new software and business architectures. The conceptual models presented in this thesis still lack enough details before they can be merged into
Chapter 5. Conclusions

a suitable business and software architecture based on flexible governance views that can measure misalignment in a SIPD company based on measurements for gaps in value and knowledge mapped to capabilities, current abilities, and needed abilities.

I suggest the following conceptual models as input to the next step of building the theory:

1. To explain the recursiveness in TCA, develop a conceptual model for how value capture and value creation can be seen as a linear process of collaboration and negotiation.

2. Connect the five organizational challenges, see Figure 3.2, by developing a conceptual model for how a gap drives change driven by value negotiation, and how actor-specific knowledge may introduce a cognitive gap when interpreting the physical gap in an interaction between two actors.

3. Explain the context of Business Model change by developing a conceptual model based on above models in combination with how an Influencer\(^1\) triggers Interaction (as a driver for Action), creating Potential impact (Risk and Opportunity) as the driver for change. The change is managed through Governance Views and a Business Model dashboard.

4. Start identifying measurements and governance views by developing a conceptual model for how two actors, based on their Knowledge and Shared understanding, negotiate Value (based on Business flexibility) while developing expectations on how their existing Abilities will match their new intended abilities, based on the contractual Capabilities.

\(^1\)The terminology used is based on the Business Motivation Model[116].
Chapter 6

A literature review on the effectiveness and efficiency of business modeling

Magnus Wilson, Krzysztof Wnuk, Johan Silvander, Tony Gorschek

Abstract

Background: Achieving and maintaining a strategic competitive advantage through business and technology innovation via continually improving effectiveness and efficiency of the operations are the critical survival factors for software-intensive product development companies. These companies invest in business modeling and tool support for integrating business models into their product development, but remain uncertain, if such investments generate desired results.

Aim: This study explores the effects of business modeling on effectiveness and efficiency for companies developing software-intensive products.

Method: We conducted a Systematic Literature Review using the snowballing methodology, followed by thematic and narrative analysis. 57 papers were selected for analysis and synthesis, after screening 16320 papers from multiple research fields.

Results: We analyzed the literature based on purpose, benefit, challenge, effec-
tiveness, and efficiency with software and software-intensive products as the unit of analysis. The alignment between strategy and execution is the primary challenge, and we found no evidence that business modeling increases effectiveness and efficiency for a company. Any outcome variations may simply be a result of fluctuating contextual or environmental factors rather than the application of a specific business modeling method. Therefore, we argue that governance is the fundamental challenge needed for business modeling, as it must efficiently support simultaneous experimentation with products and business models while turning experiences into knowledge.

Conclusion: We propose a conceptual governance model for exploring the effectiveness and efficiency of business modeling to occupy the missing link between business strategy, processes and software tools. We also recommend managers to introduce a systematic approach for experimentation and organizational learning, collaboration, and value co-creation.

**Keywords:** Business modeling, Business model operationalization, Effectiveness, Efficiency, Context-dependent, Governance, Software-intensive product development, Literature review
6.1 Introduction

Software-intensive product development (SIPD) companies experience digitalization of their business environments. The embedded flexibility that software offers merges with the high-pace technology innovation, resulting in new business opportunities for creating and capturing value in digital business ecosystems [103, 14]. This has implications for the business model.

A business model is a blueprint for a company’s business logic and a description how to manage and innovate the business. Central to a business model is how an organization creates, delivers, and captures value [118]. Business models can be seen as a set of choices and consequences of these choices (strategies and tactics) that impact the realizing organizations, business processes, products, and systems [29]. Business modeling in a business ecosystem is an activity based on transactions of activities geared toward value creation for all stakeholders [175]. Business modeling (BM) is also a practice that aims to analyze the business environment and acquire insights to formulate and drive change, by adapting and aligning the business strategy with the execution to ensure value delivery for all stakeholders [56, 72].

Optimizing value creation requires profound understanding how the implemented business model (organization, business processes, and systems) interacts with products and stakeholders for Value creation and Value capture [92]. SIPD companies have a unique position for optimally (efficiently) creating the correct (effective) value for all stakeholders. Given that software is the main component in 1) the tools for implementing and supporting core business processes; 2) developing the software product itself, and 3) integrating the product into the business ecosystem, SIPD companies could seamlessly adapt and integrate their products to their business model using business modeling [121].

The business model mediates the link between technology and a company’s performance, but the literature is missing the studies which focus on the interdependencies between business model choice, technology innovation, and success [7], as well as differentiating the value creation and value capture analysis over individual, organization, and society level [92]. Several prominent authors emphasized the lack of coherence and clear focus in the business model literature [72, 86, 174]. In particular, there is a gap in understanding how BM interacts with software-intensive products in the digitalization transformation, and what effects BM have on increasing the effectiveness and efficiency of the SIPD companies and maximizing the technology innovation realization effects.

This literature study aims to address this gap by investigating what factors determine the effectiveness of BM, and if BM can act as an enabler for improvements.
in effectiveness and efficiency of SIPD companies. This study provides a software engineering perspective on how software and software-products enable value creation as the unit of analysis for BM. This perspective enables us to narrow the scope of the vast business model literature, as well as limiting the size of the study by defining a more precise context for analyzing Effectiveness and Efficiency, as affected by the on-going digital business transformation. Based on the literature review results, we present a summary of benefits and challenges associated with BM including reported impacts on the effectiveness and efficiency of the business. Next, we synthesize the implications for the research and practice of BM and propose a conceptual governance model (CGM) for exploring the effectiveness and efficiency of BM (addressing both the innovation of business models as well as the outcome on company level for the implemented business model).

The paper is structured as follows. In section 2, we introduce fundamental concepts related to BM and theories used to investigate the multifaceted, cross-disciplinary view of BM and business models. Section 3 reports on related work to BM and its usefulness while section 4 contains a detailed description of the study design and study execution including a validity discussion. Results are presented in section 5, starting with general results around the study itself, followed by the detailed results regarding each research question. In section 6, our research synthesis including trends and our proposed CGM for exploring BM are presented. Finally, in section 7, we list six implications for researchers and industry followed by our conclusions and key statements in section 8.

6.2 Background

6.2.1 Effectiveness, Efficiency, and Governance in BM context

Business modeling shares several similarities with software engineering, requirement engineering [171, 78, 128], and Software Product lines (SPL) [17]. Software Engineering provides new possibilities to efficiently and effectively implement strategies agreed upon during business modeling activities [14].

The business model literature describes several concepts associated with effectiveness and efficiency. They are often adapted to specific contexts, e.g., organizational efficiency, manufacturing efficiency, operational efficiency, product development efficiency, and expressed as a value, time or in financial terms as for costs, revenues, profits, and margins. By starting with an “umbrella definition” offered by Webster-Merriam on-line, we will discuss definitions suitable for SIPD
companies and our study.

Effectiveness is “the power to produce the desired result”. Efficiency is defined as “the ability to do something or produce something without wasting materials, time, or energy: the quality or degree of being efficient (technical)”, but also as “the power to produce the desired result” causing some ambiguity between the two terms. Buder et al. differentiate between quality (effectiveness) and required effort (efficiency) [25]. Organizational effectiveness is discussed by Zheng et al. in combination with strategy and knowledge management, where they use the definition “the degree to which an organization realizes its goals” [172].

Effectiveness is often measured as the quality of the desired result and Fröjkjeaer et al., in their attempt to correlate Usability to Efficiency and Effectiveness, they define Efficiency as “... is the relation between (1) the accuracy and completeness with which users achieve certain goals and (2) the resources expended in achieving them” [59]. Measurements of efficiency are often related (direct and indirect) to time and cost. In Economics the term efficiency focus on different aspects of the balance between supply and demand. It is measured by the relationship between the value of ends and the value of means and examples of terms are allocative efficiency (production represents customer preferences) and productive efficiency (cannot produce more of one good without sacrificing production of another).

Effectiveness and efficiency are subjective and depend on evaluations. Such evaluations are based on an individual’s understanding of knowledge and interpretation in a specific context [126]. Therefore, having the same understanding of a context (which the measurements are relative to), is fundamental when defining effectiveness and efficiency measurements for BM (and the over-arching business context). Current research on context description in software engineering provides a useful checklist on context facets (product, processes, people, practices and techniques, and organization and market) [127]. Understanding, specifying, and sharing contextual factors (often as part of contractual agreements) is a critical factor for systematically optimizing the level of sub-optimization in a business ecosystem.

Effectiveness and efficiency are also closely related to governance, and Webster-Merriam on-line defines governance as “the way that a city, company, etc., is controlled by the people who run it”. Understanding governance is also a crucial part of BM as indicated by for example [68, 45, 175]. Jansen considers measurements and governance as the enablers of a successful software ecosystem [76]. Zott and Amit argue governance is a vital part of evaluating BM experimentation [175]. Page and Spira discuss corporate governance connected to the business model as a growing need to attain accountability by the board by considering conformance,
performance, and overseeing management control systems. They conclude that corporate governance is essentially the same thing as sustaining and developing business models [122]. In this paper, we will use the Webster-Merriam definition of governance.

### 6.2.2 Business modeling as an enabler for a company’s efficiency and effectiveness

There are many diverse and even divergent definitions of a business model and BM, as also highlighted in many literature reviews, e.g., [174, 86, 131, 72]. A business model “models the business”, but as such it has a wide range of usage depending on who and why is using it. It can be used as a description of “kinds and types” in a taxonomy to compare businesses or like a recipe for designing and innovating successful (new) business. Business models can also act as a description of the “logic of the firm”, i.e., how to create value and generate profit, or as a scale model to investigate, analyze, and evaluate different strategies and tactics, thereby supporting both strategic and daily decision making [8].

There are two ways to interpret “efficient and effective.” One interpretation is that the BM process itself should be efficient and effective. The other interpretation is that the business model realization should increase a company’s efficiency and effectiveness, i.e., BM should be the practice that increases a company’s efficiency and effectiveness. In this work, we follow the second interpretation of efficient and effective, as we are primarily interested in BM as a way to enable improvements in a company’s efficiency and effectiveness. Therefore, we base our work on the BM definition by Rohrbeck et al. as “to be a creative and inventive activity that involves experimenting with content, structure, and governance of transactions that are designed to create and capture value” [137]. This definition supports our investigation of BM for SPID companies in two ways. Firstly, looking at value creation transactions allows for a value-driven business model analysis in a business ecosystem. Secondly, by introducing the word *experimenting*, it extends BM to a process of “translating an idea into execution, testing and changing until satisfied,” similar to the Agile Software Development methods. We complement the BM definition with the proposed capabilities needed for BM (Understand and share, Analyze, Manage, and Prospect) [121].
6.2.3 Translating business strategy into execution using business models

Casadesus-Masanell & Ricart argue a clear distinction between strategy and the business model, where the business model “is a reflection of the firm’s realized strategy” and that the strategy is the plan and process to reach the desired goal, via the business model and onto tactics [29]. Among the authors that recognize the role of the business model in translating business strategy into execution, Doganova talks about the business model as a “calculative and narrative device” to innovate and translate the business strategy into execution [51]. In the same vein, Osterwalder defines the business model as a formal model to capture and translate a value-based business idea into requirements for the ICT systems and the organizations that execute that business model [121]. Höflinger defines “A business model is the design of organizational structures for converting technological potentials into economically valuable outputs by exploiting business opportunities.” [72]. For this paper, we combine our transaction-based (bottom-up) definition of BM with Höflinger’s (top-down) framework for defining the business model since:

- He extensively integrates and builds on the literature for business models.
- He addresses the issue of static versus dynamic business models (where he supports the static nature of the business model and argues business model innovation as the approach to adapt to rapidly changing environments).
- He focuses on the consequences regarding multi-value, superior performance and organizational learning as a mechanism for feedback and control.
- By taking an inside-out view of the research gap addressed in this study, i.e., based on how software and software-products enable value creation as the unit of analysis for BM, it enables both a top-down and bottom-up analysis.

Translating business strategy into execution is not an easy task and requires experimentation with content, structure, and governance of transactions that are designed to create and capture value [137]. Rohrbeck et al. advocate collaborative BM as a way to deal with the complexity and uncertainty of systems and markets. They stress the need for planning, decision making, validation, and experimentation in highly complex environments. Other scholars also acknowledged the role of experimentation in BM [36, 104, 156]. Experimentation can help to capture and manage the business environment dynamics, but it also implies new challenges in addition to just capturing and designing a business model. Some of these challenges are emphasized by Ballon when he argues “it is precisely the
alignment of control and value parameters that is of most relevance to business modeling” in his aim to describe a theoretical foundation for operationalization (preparing for execution) of the business model [9]. Ballon proposes an analytical framework for making the scope for choice explicit while connecting value to the configuration of a business model, while others formulate the main challenge as “organizations have to reach the alignment state and maintain it alongside its evolution.” [143].

6.2.4 Capturing the change dynamics and value with software products

Effectively dealing with change requires understanding how the concept of strategy relates to the business model and tactics [29], what strategic agility [52] and strategic flexibility [148] the organizations have, as well as how changeability (adaptability, agility, robustness, and flexibility) can be operationalized using modularity in design and software-based systems [133]. Flexibility and adaptability has since long been a top priority for CEOs\(^1\) and business model innovation is becoming a top priority amongst CEOs\(^2\). Hence, an important part of analyzing efficient and effective BM translates to capturing and managing the change dynamics of today’s business operations.

Value creation and Value capture are the central concepts for BM. However, there is still missing consensus on the boundaries of these concepts, based on: (1) plurality in source and target; (2) mix of content and the process; and (3) the overlap between value creation and capture. Value creation is divided into use value (as perceived by an individual) and exchange value (as the monetary compensation), and should be related to the source and the target (individual, organization, and society). Value creation is highly subjective and context-specific but always rooted in interactions. Value creation should be primarily analyzed on the individual level, while most business model literature discuss value creation on the organizational level. Value capture overlaps Value creation by discussing the sharing of value (Value slippage) to society, organizations, and individuals [92].

Moore discusses value creation in a business ecosystem and the importance to have “value-in-the-experience of customers, economics of scale, and continuing innovation”, while investing in expanding communities of allies. He defines a


business ecosystem as a complex structure of interested parties and communities interacting with each other to produce and to consume goods and services, in a partially intentional, highly self-organizing, and even somewhat accidental manner [108]. In such a volatile and increasingly complex environment, successful companies cannot just add value, but instead need to address the value-creating system itself. They must reinvent value, and work together with all stakeholders in the business ecosystem to co-produce value [113].

The flexible nature of software-intensive products opens up unique opportunities to quickly reinvent and co-produce value, but also presents new challenges for SPID companies in business ecosystems [11, 133]. Figure 6.1 illustrates an example of software-based value creation in an ecosystem, highlighting three distinct, but overlapping process areas: (1) Core Business Processes, (2) Product Development, and (3) Product Integration.

SIPD companies possess unique opportunities to harvest the flexible nature of software and reinvent value by integrating and developing native product support for each respective area and the business model(s). These areas are extensively discussed in the business model literature, e.g., covering pure software business models [147], open source/mixed source [28] and digital options [145], transitions from product-based business models to service-based models [173], or to industrial product-service systems and use models [107, 105, 133]. Even mechanical products rapidly become software-intensive products [15].

The Software Value Map (SVM) [80] explores the different value perspectives and the challenges of balancing the relevant value aspects in software development. The SVM is an extensive collection of software value aspects categorized in four perspectives: customer value; the financial perspective; internal business perspective; and the Innovation, market and intellectual perspective on value. The SVM puts precise and explicit terms on concepts discussed by Höflinger, e.g., Know-How characteristics, value structure, financial value, social value, and organizational learning. The SVM provides a necessary but often neglected bridge between product strategy, value, and operationalization of software systems and products in requirements elicitation, and decision making.

In Figure 6.1, two companies, and a customer interact in a business ecosystem. The software products are involved as agents via interfaces and features along the value delivery chain. Value is created in the interaction between two stakeholders, indicated by the arrows between the stick-men and their smiley faces. A company needs to look beyond their borders to identify all stakeholders and possible interactions for value creation (at society, organizational, and individual

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3See http://www.softwarevaluemap.org for the SVM Tool and latest details, as it is continuously updated by input from more than 50 companies world-wide, Oct-2016.
Different aspects of value are created in these interactions, while external conditions and influences shape the perception of value (as technology and society advances), often resulting in a misalignment between expected and perceived value. BM (in a SIPD context) aims to systematically capture, prioritize, and address how business logic, resources, and governance should be operationalized for optimal value creation and value capture. A software product is hence an essential part of the operationalized business model, both by acting as an agent to the business model (the content, structure, and governance of transactions), as well as through optimizing a software product’s changeability [133] to adjust for external influences.

Figure 6.1 also illustrates the recursiveness and complexity of business models and software-based value creation. Each company typically run their business model while the “overarching” business model for the business ecosystem can be seen as an aggregation and collaboration of the “underlying” business models [137]. Software Product C (e.g., a browser) is using Software Product B (e.g., a crowd-funding application delivered as a cloud service), which in turn is relying on Software Product A (e.g., a database application delivered as a service). Each company develops their software product(s) based on their (business model’s) vision and goals. They constantly need adjusting for external influences, using requirement engineering to constrain the vision and goals into an “optimal”
realization (time, opportunities, risks, features, and resources) of the software product. A software product should have features addressing (all) the needs of (all) stakeholders (throughout the complete value delivery chain). It must also support any stakeholders’ interaction with the software product throughout the product’s entire life-cycle (from the idea, design, production, commissioning, usage, to de-commissioning and obsolescence). Such role-based interaction is illustrated in the figure with features, interfaces, bi-directional arrows and the stick-men. An interaction can also be a non-human interaction between two software products, entirely internal to a company, or any combination thereof. These interactions occur at all levels in activities between actors, within and across company borders, as well as within different life-cycles of the value delivery chain.

In a business model, a transaction is an aggregation of such role-based interactions where the exchange of information, goods, payments, and feedback are not necessarily synchronized.

Also, the different software products’ life-cycles interact and overlap. This puts new requirements on the software product to more efficiently handle the introduction of new interactions and collaborations, e.g., customers being part of the design or test of Company B’s software product while Company A and B enter a partnership agreement to share costs and revenue [137]. For SIPD, this creates a tight, highly recursive relationship between BM and the software products.

6.3 Related Work

Several prominent literature reviews are published on the topics of business models. For brevity, we focus on recent publications highlighting aspects relevant for performance [72, 89, 86, 174]. Common to all reviews is the lack of empirical evidence that using BM to evolve the business model increases a company’s effectiveness and efficiency. Lambert and Davidson summarize 40 publications and report that choosing the right business model is one factor for a company’s success based on evidence of a relationship between success, business models, and business model innovation. They conclude that the studies measure and report what is the current situation, but no empirical research aims to predict company success.

Three of the reviews [72, 86, 174] highlight the two major challenges in current research on business models: 1) that business model research is too dispersed and needs a consolidation of concepts; and 2) that it is difficult to connect strategy (via business model) to execution, while capturing and handling the needed dynamics of today’s global and multi-stakeholder business environments. Other
prominent researchers also highlight the lack of a consolidated body of knowledge and concepts [158, 45, 109, 121], indicating a gap in understanding BM’s real-world effects.

Business models for explaining a company’s performance are frequently discussed both conceptually [1, 2] as well as empirically [70, 176, 178]. Hacklin and Wallnöfer conclude that the business model acts more as a symbolic artifact and not as an analytic tool. Zott and Amit report empirical evidence suggesting that business model design can provide a competitive advantage, but does not provide conclusions that employing BM to evolve the business model will improve a company’s effectiveness and efficiency. Lambert and Davidson studied the relationship between company success, business models and business model innovation. These studies all measure and report what is the current situation, but there is no empirical research that aims to predict company success or to conclude that business modeling enables effectiveness and efficiency of a company [89].

Osterwalder et al. advocate formalization of business models using IS/IT tools and an experimental approach "when-and-how-to-build" [119]. Their eight propositions to be observed and eventually tested seems still be equally valid: 1) use rigorous meta-models; 2) increase understanding business and IS/IT; 3) improve integration business and IS/IT; 4) facilitate and improve IS/IT choices infrastructure/applications; 5) facilitate choices IS role and structure; 6) help defining company’s goals; 7) facilitate identification of key indicators; 8) externalize, map and store knowledge of value creation logic [121].

Giessmann et al. extend Osterwalder et al.’s propositions to build a model that can analyze and compare business models, but their work does not address the issues of aligning and daily execution of a business model [64]. Salgado et al. also build on Osterwalder’s Business Model Canvas (BMC) and discuss how to generate a BMC from business goals, rules, and processes, but do not further connect the results to the IS/IT realization and daily operations [144]. They also discuss the alignment between business and IS/IT (from the lens of business model artifacts, enterprise modeling, and strategy and goal modeling) and formulate the main challenge as “Achieving alignment per se is not enough, organizations have to reach the alignment state and maintain it alongside its evolution.” [143].

The literature indicates a research gap between modeling the business and executing the business model and more specifically, do business modeling increase a company’s effectiveness and efficiency? Höflinger’s framework extensively builds on the literature but does not empirically define or explore his angle of “superior performance”, nor the dynamics of a business model related to value. Further, he does not explore how the learning of an organization interacts with the de-
sign of, the representation of, and experimentation with a business model [72]. Rohrbeck et al. stop at the preparation for development and do not provide further insights into the mechanics needed for actual experimentation and validation of a business model [137]. Richter et al. discuss flexibility and value as a way to deal with change and implementation of business models. They conclude that further work is needed to better understand inter-firm governance structure [133]. Ballon proposes an analytical framework for making the scope for choice explicit and concludes that further work is needed to make interdependencies of parameters explicit and to extend the model in a more prospective and predictive sense [9].

6.4 Methodology

6.4.1 Research questions

We used software and software-intensive products as the unit of analysis. The rationale comes from the central role that software-intensive product play in the on-going business environment digitalization transformation. We focus on the following two research questions:

RQ1: What benefits and challenges of business modeling are reported in the literature?

RQ2: What effects related to effectiveness and efficiency of business modeling are reported in the literature?

We used RQ1 to investigate the contextual setting for business modeling and to compare and analyze the reported effects on efficiency and effectiveness. The on-going business environment digitalization transformation heavily depends on flexible and scalable software solutions. Therefore we limit the scope to business modeling for SIPD companies developing software-intense products and services. The research process executed in this study is outlined in Figure 6.2.

6.4.2 The Snowball methodology

Our Systematic Literature Review (SLR) methodology is based on the guidelines for snowballing literature search proposed by Wohlin [165]. The snowballing methodology is considered less noisy compared to a similar database-search based methodology and the critical step for a successful snowballing is to choose a good tentative start set characterized by 1) studies from different communities; 2) size
Figure 6.2: Research methodology overview

appropriate for the studied area; 3) diversity of publishers, years, and authors; and 4) is based on the research questions and keyword. The complete study was conducted in four steps, outlined in the subsections below and depicted in Figure 6.2. We screened 16320 papers resulting in 57 papers included in the study.

STEP 1: Design of the literature review

To minimize the author-bias and to prepare for a cross-disciplinary study (business management and software engineering), we performed two open-ended interviews to identify further reading to understand the terminology to formulate our research questions. These interviews helped us to decide upon the methodology, validity risks, inclusion criteria (IC) and data extraction properties. We also created a study protocol and documented each step and decision. The same IC were used defining both the start set and in the following snowball iterations, see Appendix A.2.
STEP 2: Defining the start set

We used a database search in Google Scholar to find the start set and recommendations from the interviewed experts. The two initial interviews (60-minutes, open-ended interview with the question “Does business modeling enable improvements in effectiveness and efficiency for a company?”) with experts in Software Engineering (telecommunication industry with 25 years of experience) and Business management (professor in production management) resulted in a starting point of:

- four recommended studies, of which Höflinger also ended up in the start set [72].
- a wide multi-disciplinary map of subject areas: Computer science; Software Engineering; Business Management and accounting; Economics econometrics and finance; Organization management; and Decision Science.
- additional keywords - Open Innovation, Strategic Management, Value Creation, Value Capture, Flexibility, Business Model innovation, Business Ecosystem, Organizational theory, Knowledge management, Service Science, Enterprise architecture, Software Product Lines, Open source, and Product Service systems.

After further search in Google Scholar for definitions on these keywords, we created a recommended Golden Set (31 papers) from which we derived a collection of definitions to help us penetrate the terminology. The snowballing methodology recommends using Google Scholar to avoid any bias on specific publishers [165]. The definitions helped us develop the search strings (SS). We used a traditional search schema with iterative clustering to reduce the number of hits while minimizing noise (initially in Scopus since it contains all the subject areas). We ended up with two search strings, see Table 6.1, used to query six databases, see Figure 6.2.

<table>
<thead>
<tr>
<th>Id</th>
<th>Terms</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS1</td>
<td>(business model OR business ecosystem) AND value creation AND strategy</td>
</tr>
<tr>
<td>SS2</td>
<td>(“business modelling” OR “business modeling” OR “business ecosystem”) AND “business strategy” AND “value creation” AND (“effectiveness” OR “efficiency” OR “business flexibility” OR modularity OR “variability in realization” OR “governance” OR “multi-business”)</td>
</tr>
</tbody>
</table>

4SS1 uses stemming and SS2 doesn’t. Also, “multi-business” was added upon recommendation of industry expert, since executing several business models in parallel is a significant challenge for large SIPD companies
Executing SS1 and SS2 (limited to title-abstract-keys) resulted in 2948 papers, see Figure 6.2. The first author applied the inclusion criteria on titles and abstracts, and 2378 papers were removed. The remaining 570 papers were put in an excel sheet so duplicates and not peer-reviewed papers could be discarded. The final 477 papers were screened more thoroughly (abstract, introduction, conclusion) for IC and the result discussed and validated with the second author, leaving nine papers to be included in the start set. One paper recommended by the experts in business management was also included in the start set.

**Step 3: Execute Snowballing iterations**

The first author collected the references of citations to the papers selected in each iteration. Next, we applied inclusion criteria and calculated the Cohen’s Kappa in all iterations, see section 6.4.3.

In total, we screened 10414 citations and 2958 references, see Figure 6.2. Iteration 1 covered the start set and resulted in 35 selected studies (out of 612 references and 249 citations). Iteration 2 resulted in 2011 references and 10134 citations. The noise in citations is one of the downsides reported for the snowballing methodology, and we applied an initial pre-screening (language, title, abbreviated abstract) giving us a remaining 1335 citations to screen. By having the candidate list in Excel, it was easy to detect all duplicates. We selected 11 studies in iteration 2. Iteration 3 rendered 313 references and 30 citations resulting in one new paper selected. We got a natural stop of the snowballing procedure by iteration 4 with no more studies discovered resulting in a total of 10+35+11+1 = 57 studies selected for analysis, see Appendix A.1 for a complete list.

**STEP 4: Data extraction, analysis, and synthesis**

Appendix A.3 outlines the data extraction properties (EP) used in this study. ATLAS Ti\(^5\) and Excel were used to keep track of and analyze results as well as synthesize extracted information. The extraction was done by the first author and validated by the other authors, see section 6.4.3.

Properties EP1-EP4 were evaluated per paper and used to analyze the relevance to industry for each paper’s contribution. The property EP3 (Rigor & Relevance) was also used for quality assessment, see extracted raw data per paper in Appendix A.1A and detailed calculations in Appendix A.3. It helped us to evaluate generalizability of the results, see section 6.4.3.

Open coding [39] was used for properties EP5-EP9 and the extracted data was thematically analyzed. Properties EP5-EP9 helped us synthesize results regarding BM as phenomena as well as to identify potential research gaps.

The results were iterated in two phases (a) RQ1 and (b) RQ2. For each phase, the first author prepared a summary of listed quotations from all studies. The list was then reviewed against the extracted result, and the first author had to explain a summary of each paper’s findings to the reviewer. Phase (a) were reviewed by the second and third author, while phase (b) were reviewed by the second author.

6.4.3 Validity threats

We adopted the validity guidelines suggested by Runeson et al. [140]. An extensive industrial experience of the authors may have influenced the aims of the study with a stronger bias towards solutions. We mitigated that bias by two initial interviews and an iterative refinement of the research questions and also by applying a grounded theory approach [39], fostering a focus on the merits of each paper before an end-to-end perspective could be evaluated.

The selected ten papers in the start set are highly heterogeneous and therefore minimize the bias on specific author or terminology. Similarly, we mitigated the author’s bias by calculating the Kappa coefficient when selecting the start set papers. The Kappa analysis was done by the first and second authors, and the value was $k=0.566$ and later increased to $k=0.638$. The Kappa analysis was also performed during the first snowballing iteration on 12% of the studies with a resulting value of $k=0.763$. These values represent sufficient agreement and increase the validity of the study.

To mitigate author bias during extraction, six random studies were selected (of the 57 studies) and extracted by the first and second authors. The validation showed a discrepancy of one paper for extraction properties EP1-EP4 and after further discussion full agreement was reached. Also, the results to the RQs (EP5-EP9) was iterated in two phases, and each phase was presented by first author before discussed and evaluated by at least one more researcher.

Rigor and relevance analysis was applied to mitigate potential threats to conclusion validity. The rigor classification based on software engineering literature was also adapted for business modeling literature. The relevance parameter was coded using binary weights (0,1,2, and 4 instead of the recommended 0 and 1). We also decided to add property EP4 to specifically address the relevance of a paper’s content concerning our RQs (since the property EP3 and its’ relevance
aspects only consider the research method and context of a paper). This provided higher resolution when discussing the relevance and when thematically comparing the papers. The extraction of results was iteratively reviewed and discussed with second and third authors. We minimized potential internal validity threats by following the systematic mapping study guidelines, creating a review protocol and sharing the work associated with data extraction and analysis.

Since this study covers studies from a wide set of research fields, the semantics (and context) of words can often be misleading. We addressed this by our choice of a snowballing methodology in combination with a rigor design to identify the start set. Moreover, we used open coding (inspired by grounded theory [39]) to synthesize and harmonize language between the different research fields.

Because of the interdisciplinary nature of this study, the risk remains that some aspects are underrepresented and other aspects are overrepresented. In particular, business model innovation or business process modeling seems to be heavily researched in the business management and the computer science community. However, we decided to limit the scope in these dimensions since our primary interest is the interplay between the strategic intentions, the design of a business model, the realization of it, and the resulting effects on efficiency and effectiveness, rather than details on how individual steps are performed.

We selected our start set studies from different research disciplines and these studies are conducted using many different research methods which improve the external validity of our literature review. Even though the start set is carefully chosen and includes publication years (2004-2014) there are only 17 (out of 57) papers published during 2013-2015.

### 6.5 Results and Analysis

Table 6.2 shows results related to research questions mapped to each paper’s context (data extraction property EP4, see Appendix A.3), including frequency and summarizing comments. Using inclusion criteria IC2 and IC3 we investigated if the papers address flexibility without further exploring the efficiency or effectiveness.

74% of the identified studies (EP4, categories 2 and 3) focus on the business model construct rather than the BM as a practice. One reason for this could be that BM as a practice is a broad, diverse topic forcing researchers to limit the scope by addressing some aspects of a business model construct rather than BM as an activity or process. Still, only 33% of the paper address both RQ1 and RQ2.
Table 6.2: Results mapped to research questions and paper context

<table>
<thead>
<tr>
<th>RQs /ICs</th>
<th>Business modeling (1)</th>
<th>Business model (2)</th>
<th>Other (3)</th>
<th>Sum</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ1</td>
<td>2,6,15,17,18,35,36,</td>
<td>1,3,5,7,9,13,14,16,</td>
<td>8,10,12,26,30,31, 50</td>
<td></td>
<td>Scattered in a multitude of practices and frameworks. Results suggest lack a systematic alignment of contextual information hindering re-use and integration of practices.</td>
</tr>
<tr>
<td></td>
<td>37,41,49,51,52,53,</td>
<td>19,20,21,22,24,29,</td>
<td>34,38,42,43,46,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>54,56</td>
<td>32,33,39,40,45</td>
<td>48,55,57,58,59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RQ2</td>
<td>17,35,37,54,56</td>
<td>1,5,24,29,32,45</td>
<td>8,42</td>
<td>13</td>
<td>Quotes on effectiveness and efficiency are not differentiated nor substantiated.</td>
</tr>
<tr>
<td>IC2</td>
<td>2,6,17,18,35,36,37,</td>
<td>1,3,5,7,9,13,14,19,</td>
<td>8,10,12,26,30,31, 42</td>
<td></td>
<td>Many papers reflect over flexibility. Governance is important for understanding the value (and cost) of (the right) flexibility in order to optimize the value creation and value capture.</td>
</tr>
<tr>
<td></td>
<td>41,49,52,53,54</td>
<td>20,22,24,27,29,33,</td>
<td>34,38,48,55,57,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>39,40,45</td>
<td>58,59</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IC3</td>
<td>2,6,15,18,35,37,49,</td>
<td>1,3,5,7,9,13,16,19,</td>
<td>10,12,26,31,34,    35</td>
<td></td>
<td>Variability in the realization is an important aspect of flexibility and should be a part of the business modeling analysis.</td>
</tr>
<tr>
<td></td>
<td>51,52,54,56</td>
<td>21,22,24,27,29,32,</td>
<td>43,46,55</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>33,45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sum of papers</td>
<td>15 (29%)</td>
<td>20 (39%)</td>
<td>16 (31%)</td>
<td></td>
<td>The % is calculated of the 51 papers adressing RQs+ICs. 6 papers of the total 57 selected papers did not specifically address any of the RQs+ICs. They all belonged to category 3 – Other.</td>
</tr>
<tr>
<td>Hit rate</td>
<td>33% (5)</td>
<td>30% (6)</td>
<td>9% (2)</td>
<td></td>
<td>The 'hit rate' is the ratio of papers addressing both RQs. For category 3 the ratio include the 6 papers (not listed in the Table) not addressing any RQs.</td>
</tr>
</tbody>
</table>
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Figure 6.3: Papers plotted for frequency(size), Rigor (X-axis) and Relevance (Y-axis) scores, and Paper context (font)

The number of papers addressing multiple RQ+IC is growing since 2005. As the area becomes more mature, it is also becoming more complex, multifaceted, and cross-disciplinary. This trend is also indicated by Kindström where he states “that companies need to focus on all areas of their business models in a holistic fashion, and not just change isolated elements” [P24]. Similar, Reim et al. concludes that more research efforts are needed on the complicated relationship between strategic and operational levels [P3]. This could be one of the reasons why business model research is still scattered and disperse. To evaluate BM efficiency, it is therefore essential to connect the business strategy via the business model to the execution of the business model with traceability to daily operations and results.

We used Rigor and Relevance (EP3) to analyze the identified papers, see Figure 6.3 and Appendix A.1. 60% of the studies received industry relevance scores greater than 7, representing a good balance between state-of-art and state-of-practice. A majority of these studies (20) score 15 (highest), and additional eight studies score > 9 (two or more conditions met). The included literature reviews [P3, P9, P29, P40] have (as expected) a relevance score =0 with acceptable rigor scores (>= 1). The remaining 19 studies with a non-industry relevance score, discuss specific topics or more general frameworks and methods/aspects (related to
BM) divided on: strategy [P15, P19]; life cycles [P25, P28]; effectiveness and efficiency [P35]; flexibility [P27]; static/dynamic [P14, P34]; or frameworks, methods and models [P8, P10, P16, P18, P22, P31, P32, P41, P44, P57, P59].

45% of the studies are coded with a low rigor (score 0 and 0.5) where 11% only describe the context, but not mentioning any design or validity aspects. The validity aspect is the single most lacking aspect lowering the rigor in 54% of the 22 studies with medium rigor (score 1, 1.5 and 2). Different research fields are different regarding maturity, methodology, and best practices on how to report the research, which we believe are the main reasons affecting the rigor aspect.

6.5.1 Benefits and challenges associated with business modeling (RQ1)

We extracted 263 quotes of purpose, benefits and challenges of business modeling (EP5), see Appendix A.4. Quotes of purpose (P) often sets the general context, while quotes of challenges (C) or benefits (B) often are reflections of how well a solution to a specific problem works. Benefits refer to a solution with good enough result while challenges refer to potential issues to obtain a satisfactory result (judged by specific qualities and contextual factors). We identified the following common areas (rows in Appendix A.4): 1) Value creation/capture; 2) Cost/Revenue; 3) Mind-set and Knowledge; 4) Means⁶ (Mission, Strategy, tactics, directives, organization, and resources); 5) Ends⁶ (Vision, goals, and objectives); and 6) Assessment⁶ (decision control, clarity, visualization, influencer, etc.).

Our literature review results suggest that the overarching purpose found for BM is for a company to stay competitive and improve its business results. The quotes of purpose are often overlapping and cover a wide variety of more specific topics, like managing individual business aspects (e.g., offerings, market, cost and revenue), capturing the business logic and activity systems, over to a holistic nature like ‘operationalize strategy’, appropriate value from technology, or managing value (co-creation, capture, creation) and partners. Investigating the quotes further, we identified three primary contexts for BM (columns in Appendix A.4): 1) Strategy and planning; 2) Daily operations (executing strategies and plans); and 3) Governance and communication.

To analyze potential ambiguity (per paper) between the primary context of purpose quotes vs. the primary context of benefits/challenges quotes, each quote

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Figure 6.4: Quotes binned on purpose, benefits+challenges, and distributed over the primary contexts

is tagged with Paper Id, Type of quote (one of P, B, C), and Primary Context (one of 1,2,3). Figure 6.4 illustrates the number of papers adhering to different contextual coherence bins distributed over the three primary contexts. We define the five contextual coherence bins. Bin 0 equals a paper having zero quotes in a primary context. Bin 1 equals a paper having quotes of P and B/C only in different primary context. Bin 2 equals a paper having only quotes (B/C) for a primary context. Bin 3 equals a paper having only quotes (P) for a primary context, and Bin 4 equals a paper having quotes of both P and B/C in same primary context.

Strongest contextual coherence is found in bin 4, with the highest ratio for the primary context “Governance & communication” at 16% (15 papers). The most significant contextual ambiguity (bin 1) is found in 4 papers [P8, P13, P19, P49] where a purpose is stated in one primary context while the benefit or challenge is claimed in another primary context without specific detailing the relationship. Romero & Molina discuss the purpose of value co-creation, as a complicated cooperative process (speed, coordination, compromise) with the challenge of managing the experience-sharing network, and how that affects the business modeling [P8]. Chesbrough discusses business model innovation with purposes related to formulating competitive advantage, value proposition and value chain definition while concluding challenges as a lack of tool support and continuous learning associated with BM experimentation [P13]. Richardsson discusses the purpose of formulating and achieving goals and objectives while concluding challenges as managing the different abstraction levels towards execution and getting the details right.
Eurich et al. discuss the purpose of transforming the business opportunity into an organizational implementation via experimentation and business model fit, while concluding challenges in practical aspects like lack of details, not aligned design processes, disregard of external influences, etc. Moreover, a significant portion of the papers lack statements on purpose, benefit, or challenge making a discussion around effectiveness and efficiency more challenging due to vague contextual information. Our results highlight a challenging issue how to effectively and efficiently defining contexts to improve understanding and communication in BM literature.

The importance of contextual information is mentioned by seven studies [P8, P17, P18, P20, P25, P51, P59], but no author goes as far as to suggest how to describe or represent the contextual information. At the same time, the current research on context description in software engineering provides a useful checklist on context facets (product, processes, people, practices and techniques, and organization and market) [127]. However, these context facets are ambiguous in themselves, e.g., a market consist of products, customers, and organizations, a product could be a service and therefore include a process, etc. As a reflection of the identified challenges and claimed benefits, related to the paper’s contribution to practices and methods for BM (including effects on effectiveness and efficiency), the underlying purpose is contextually vague with statements like “Operationalize strategy” [P36, P37], or “Deal with uncertainty” [P2, P52, P54]. The papers offer no empirical evidence to support that the purpose can be realized with claimed benefit nor do they quantify the extent of the challenges.

Similarities between the quotes on benefits and challenges are found, but only eight quotes are reported by multiple authors, for example: ‘(-) difficult managing dynamics (agility, adaptability, planning, decision) for alignment to environment and other organizations’ [P2, P5, P7, P9, P36]; ‘(-) hard to visualize, document and share’ [P26, P32]; ‘(-) difficult to mobilize and align available resource in time’ [P9, P15]; ‘(+)- better understanding, better language and legitimacy’ [P17, P32]. We speculate that this low level of coherence between the papers is a result of the wide topical area of BM. We also note that seven of these eight quotes discuss common topics of governance (‘handle dynamics’, ‘align’) and knowledge (‘understanding’, ‘sharing’, ‘legitimacy’, etc.), while the remaining statement covers value creation.

There are also cases where the same type of statement is argued both as benefit and challenge (by different authors). For example, (+) ‘building better strategies’ [P32] vs. (-) ‘BM design requires better integration with strategy analysis’ [P37] or (+) ‘improves dealing with uncertainty’ [P2] vs. (-) ‘difficult to deal with uncertainty, complexity and dynamism’ [P54] or (+) ‘improves alignment of strategy, organization and technology and integration business IS/IT domains’
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[P32] vs. (-) ‘hard to reach and maintain alignment of business model and information system model’ [P59]. This kind of ambiguity can be a result of the wide topical area of BM in combination with a poorly specified contextual setting, opening up for a different interpretation of results.

The majority of the quotes are found in the union of (Governance) — (Mindset, Knowledge) — (Assessment) indicating that learning (knowledge) and control (governance) is key to BM. This is also backed by [P5, P13, P32, P51] which discuss the importance of experimentation and learning to adapt to the changing environment. The changing environment is also highlighted by [P2, P9, P49] as a challenging fact of business models, and as McGrath concludes, everything cannot be planned, but rather adapted to a suitable fit [P18]. In the same vein, we notice the vast number of papers belonging to bin 0, 2, and 3, indicating that a majority of the papers focus on a single primary context of BM, rather than connecting the strategy to the execution and evaluating the business outcome (as a consequence of the BM practice).

Summarizing the results, the most common challenge is how to deal with the dynamics of business models [P2, P5, P7, P9, P36] and most of the quotes on challenges relate to the non-existing solutions for governance (representation, simulation, decision-support, and feedback) of the proposed frameworks and methods. Since governance is not addressed, each BM method or framework may work in its’ specific context, but taken out of context or combined with other methods may fail to deliver the claimed benefits. Also, the quotes of benefits are unsubstantiated or claimed with limited empirical evidence (except for an empirical case which evaluates and compares user’s understanding of two value models [P35]).

6.5.2 What impact does BM have on effectiveness and efficiency (RQ2)?

Only two studies make a clear distinction between the terms effectiveness and efficiency [P5, P35] where Chew and Buder & Felden both specifically link effectiveness to quality and efficiency to effort to perform a task. Zott et al. recognize efficiency as an important value driver, and that any value driver can enhance the effectiveness of the other drivers [P29]. Osterwalder et al. connect efficiency to infrastructure management while effectiveness is indirectly connected to value [P32]. Chew and Romero & Molina connect effectiveness to customer experience [P5, P8]. Mason & Mouzas argue efficiency is a product of careful management of resources and capabilities driven by a “network focused” approach while effectiveness (via marketing) is a product of being market-focused to keep in touch
with changing customer needs by flexible products and service offerings [P58].

The terms are also used on different abstraction levels hindering in-depth analysis. We believe this is a likely result due to the combination of: 1) none of the 57 studies have research questions that directly address effectiveness and efficiency; 2) that business model research is still not coherent with a consolidated view of what a business model is used and useful for; and 3) few scholars address both primary contexts of strategy and the execution making an evaluation of effectiveness and efficiency difficult.

Measurements of effectiveness, efficiency, and company’s performance (as an expected outcome of efficiency and effectiveness improvements) are neither sufficiently described nor substantiated. Measurements of effectiveness were only explicitly defined by Buder & Felden where they used a ratio of correctly answered questions to evaluate the effectiveness of individual methods about understanding value [P35]. No explicit measurements on efficiency or company’s performance were found amongst the papers, except for Andries & Debackere who suggested company’s survival rate to measure its performance for new technology-based business models [P42]. Ghezzi discussed how discontinuity can be detected before it affects a company’s performance but does not mention how to measure the performance [P37]. A company’s performance is also referred to by different terms but not further substantiated, for example by profitability [P29], value creation [P29], organizational performance [P29], operating cost or gains in productivity [P54]. We found no empirical evidence (except [P42]) to substantiate claims on effectiveness and efficiency. We also note that all 13 papers addressing RQ2 also address aspects of flexibility and variability in the realization (IC2 and IC3, see Table 6.2).

Indirect effects on effectiveness (and efficiency via profitability) are reported by three papers [P24, P29, P37]. Kindström discusses the transition to the service-based business model as a key to remaining competitive [P24]. He does not make any specific claims about effectiveness or efficiency, but proposes focusing research efforts on: 1) how to industrialize service offerings to a larger scale; and 2) understanding how a transition to service-based business models affects profitability and growth. Zott et al. in their literature review acknowledge the possible contingent effect of BM linking product market strategy and company performance [P29]. They also refer to a study by at IBM Global Business Services in 2006 that says financial out-performers put twice the effort on business model innovation compared to under-performers, but do not further elaborate as on how. Ghezzi looks at the strategic planning process and BM under discontinuity [P37]. He concludes that the ‘business model parameters mix’, as derived from the different business model blocks, directly affects the company’s performance. He provides a strategy-analysis tool based on BM, VN, and RM constructs (business
model, value network, resource management), to detect what is changing in the company’s strategy when discontinuation occurs, but he does not discuss in any detail how to derive any changes in effectiveness or efficiency.

**Summarizing** the results, we found limited empirical results indicating that BM has an overall effect on a company’s results regarding effectiveness and efficiency improvements. It is also not possible to judge whether a favorable outcome can be achieved in a scenario of continuous (experimental) BM, or it is just a result of a one-time activity to modify the business model. Also, we note that all 13 papers addressing RQ2 also address aspects of flexibility and variability in the realization. These limited results prompt us to do a contextual analysis of the effectiveness and efficiency of BM.

### 6.5.3 Contextual analysis of effectiveness and efficiency

We base our analysis on the two main contextual BM settings: 1) the business model realization should increase a company’s effectiveness and efficiency; and 2) the effectiveness and efficiency of the BM process itself.

For **increasing effectiveness and efficiency** (contextual BM setting 1), we found the same three primary contexts as reported in Section 6.5.1: 1) Strategy and planning; 2) Daily operations (executing strategies and plans); and 3) Governance and communication, see Table 6.3. From these contexts, we identified three patterns (Full, Partial, and Single) describing whether a paper covers all three contexts or parts of them. The patterns are derived from the first three columns (Define, Execute, and Governance) in Table 6.3. Full means that the paper does address topics in planning and strategy, daily execution, plus governance and communication contexts. Partial refers to any combination of two contexts, while Single refers to only one context. We also analyzed the papers according to the three key areas aggregated from the studies: value creation/capture; decision support; mindset and knowledge.

The **BM process’ effectiveness and efficiency** (contextual BM setting 2) are discussed by 3 of the 13 studies [P35, P54, P56]. Buder & Felden recognize the hurdle of keeping models consistent during transformations and suggest a specific value representation model as a remedy [P35]. Salgado et al. propose a method for modeling and visualizing requirements on the Define and Execute processes of the business model [P56]. Both studies offer limited empirical evaluations. Meier & Bosselau recognize the importance of a continuous, integrated BM to capture the dynamics of the ecosystem [P54]. It is the only paper clearly discussing the importance of not separating the process of BM from the actual Define and Execute processes of the business model. However, they do not quantify any
### Table 6.3: Identified effects on effectiveness and efficiency

<table>
<thead>
<tr>
<th>Pattern and Key areas</th>
<th>Strategy &amp; Planning (Define) (contextual setting 1)</th>
<th>Daily operations (Execute) (contextual setting 1)</th>
<th>Governance &amp; communication (contextual setting 1)</th>
<th>Business modeling (contextual setting 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Full pattern</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>P54</td>
</tr>
<tr>
<td>P1, P5, P8, P24, P29, P54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Partial pattern</strong></td>
<td>X</td>
<td>-</td>
<td>X</td>
<td>P56</td>
</tr>
<tr>
<td>P32, P37, P56</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P42</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Single pattern</strong></td>
<td>X</td>
<td>-</td>
<td>-</td>
<td>P35</td>
</tr>
<tr>
<td>P17, P35, P45</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mindset and Knowledge</strong></td>
<td>-</td>
<td>Capitalize user’s knowledge for innovation (idea generation, prototyping) [P8] Cumulative changes have a positive effect on learning and success rate [P42]</td>
<td>Formalizing activities forces implicit understandings become explicit [P17] Generating and transferring of insights is key for reuse, e.g., business model cockpit [P54]</td>
<td>-</td>
</tr>
</tbody>
</table>
effects on effectiveness and efficiency, while concluding that tools are a necessary focus for further research. We believe the lack of empirical results is a direct consequence of: 1) the wide contextual settings for business model research; and 2) the lack of consolidated view on what a business model is used and useful for. Given our study’s primary focus (contextual setting 1), we also interpret the ratio of papers addressing our main contextual setting (77%) as a quality measure of our study design.

Full pattern category papers [P1, P5, P8, P24, P29, P54] advocate that to yield effectiveness and efficiency, the overall focus is how the plan/strategy/goal should be aligned with the execution of the strategy. Woodard et al. discuss how “design moves” enable rapid product development in a new domain with fierce competition and how to formulate and execute digital business strategies (align strategy to execution) based on option value and technical depth [P1]. They propose decision-support via option value and technical depth to integrate the perspectives of designers and corporate strategies. They empirically illustrate effectiveness and efficiency from a set of design moves but do not state on what level anything became more efficient.

A transition into service-based business models to improve competitiveness and efficiency of the business model is proposed by three papers [P5, P54, P24]. Chew argues that business model design impacts directly financial performance but does not state how nor to what extent it affects effectiveness [P5]. Effectiveness is a result of service variability and aligning the three contiguous processes for optimal value co-creation (customer value-creating, supplier value-creating, and the service encounter processes). He focuses on the Define process with a service design concept to understand the customer needs and value appropriation, and concludes that execution also requires “support by a corresponding modular organizational architecture as well as IS architecture”. Meier & Bosslau discuss the difficulties when transitioning from a product-centric business model into a product-service-centric model, with empirical findings that only 21% of manufacturing companies succeed in this transition [P54]. The fundamental problems are: a drop in efficiency, diversified portfolio, and an increased cost due to an increased product-service portfolio without a matching increase in revenue. They propose an iterative learning process based on an integrated business model design and engineering using System Dynamics (SD). SD is used to specify the business models run-time behavior over time, but they conclude that the provision and further development of this approach are crucial in further studies. Kindström identifies vital aspects in Define, Execute and Governance when changing into a service-based business model, and also recognizes the challenge of staying profitable [P24]. However, he makes no specific contribution how to improve efficiency or effectiveness and concludes that more research is needed to
link a transition to profitability and growth.

To enhance the effectiveness of collaborative networked organizations, Romero & Molina propose an experience-centric network reference framework based on open-business models (co-innovation/open innovation) [P8]. By integrating a multi-value perspective with a multi-stakeholder approach, one can capitalize on the networked organization’s knowledge to achieve better business models (e.g., better risk management and transparency through value co-creation). They present no evidence for improved effectiveness or efficiency.

Partial pattern category papers [P32, P37, P42, P56] focus on the Define process in combination with Governance to ensure the expected results. Osterwalder et al. discuss how a formalized model can help to react to external events with speed and effectiveness, but presents no empirical evidence thereof [P32]. Salgado et al. argue that the gap in the business-IS/IT dialogue, which in turn leads to inefficient and non-effective IS/IT solutions, partly comes from: 1) the lack of formality; and 2) high dependency on specific and skilled analysts, when deriving IS/IT requirements from business goals [P56]. They propose the use of PGR (process-level use cases, goals, and rules) to improve traceability and the alignment of Business and IS/IT as a way to improve effectiveness (of both developing and running the IS/IT solution). To close the gap in the business-IS/IT dialog and increase efficiency, they propose a method how to generate a BMC from goals and rules to improve decision making and increase traceability. The method has only been tested on a small, manual scale with considerable limitations: 1) a high dependency on individual analysts and their knowledge and business heuristics; and 2) limited scope due to the amount of human resources needed. Conclusions on effectiveness and efficiency for their work are too early to derive. Ghezzi discusses business strategy under discontinuity and presents three tools to help managers identify a signaling “vector of inputs” to trigger a strategic re-planning process [P37]. He refers to the relation between the business model performance and a company’s performance but makes no claims on effectiveness or efficiency with his contribution. Andries & Debackere instead look at the Define and Execute processes in their discussion how adaptation and performance are related to new technology-based businesses [P42]. They conclude that business model adaptation is beneficial in less mature, capital-intensive and high-velocity businesses, as it reduces failure rates in dependent business units. However, they do not detail how this can be done using BM.

The Single pattern category includes studies [P17, P35, P45] focusing on the Define process and advocates more research addressing effectiveness and efficiency. Hacklin & Wallnöfer discuss how the business model is applied for strategic decision making [P17]. They explore implications and limitations of using a business model as a “strategizing device” and how BM is forcing to formalize current ac-
activities and make implicit understandings. They propose future research on the effectiveness of business: 1) deal with technical aspects how to systematically use BM to improve effectiveness; 2) to test the linguistic legitimacy of various frameworks for BM; and 3) improve the effectiveness of different representational modes of the business model to gain pragmatic validity. Buder & Felden evaluate the efficiency of representation and formalization of value models (e3value and REA) to understand business models [P35]. They discuss the impact of business processes on value creation and stress the importance of consistency between business and process modeling. They find e3value to be more effective and efficient in improving the linkage between BM and business processes. Doganova & Eyquem-Renault investigate the commercialization of technology in the first years of new ventures and the dual role the business model play [P45]. They argue the “performative” role as a demonstration and as a scale model that gradually bring the company’s business into existence. They also conclude that empirical findings still fail to provide convergent results regarding the effectiveness of business models.

To summarize, the improvements associated with efficiency and effectiveness are neither substantiated by empirical evidence nor grounded in empirical data. Given the diverse contextual settings in the studies and the dependence of the BM approach, it remains an open question whether the application of any of the identified practices results in increased or decreased efficiency or effectiveness for a company’s business. Any outcome variations may simply be a result of fluctuating contextual or environmental factors rather than the application of a BM method or technique. Reaching reasonable coverage of efficiency and effectiveness as external factors require considering several measurable internal factors. With a reasonable coverage of relevant internal factors and taking into account contextual factors, we most likely operate on tens of independent variables that need precise definition and measurement instruments. Given this, we argue that none of the identified studies come near to the required level of details to be able to consider their measurements trustful (except for Andries & Debackere linking business model adaptation to a company’s performance via a survival rate measurement and other variables collected from the annual CorpTech directory [P42]).

We concur with Zott et al. that “literature is developing largely in silos, according to the phenomena of interest to the respective researcher” [174]. We conclude that business model research still lacks a consolidated view of what a business model is, while at the same time being forced to address more complexity (e.g., dynamic business models, co-creation, collaboration, and ecosystems with a growing number of stakeholders).
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6.6 Research synthesis

6.6.1 An analysis of business modeling trends

We synthesized five main trends within our surveyed literature on BM:

- Business models as the building blocks, and the structure of a business model construct as a cornerstone for analyzing, planning and managing competitive and strategic advantages [P1, P2, P3, P4, P9, P13, P16, P19, P29, P32, P40, P41, P51]. Much research is put into frameworks, methods, and tools but the effectiveness and efficiency when integrating this research into practical solutions still miss empirical evidence.

- Locus of the company is shifting to the ecosystem resulting in an explosion of new roles and values that need consideration, as they are connected to the value creation/capture logic [P2, P3, P4, P6, P21, P53, P57]. This trend makes future research more complicated and time consuming, given the lack of consolidated body knowledge on what a business model is and how it can be represented to support experimentation and efficient information management.

- Experimentation and operationalization of flexible business models, to manage the speed of change fueled by technology innovation and the digitalization of the value delivery [P1, P2, P9, P13, P15, P18, P49, P51]. We too, argue for a more cross-disciplinary agenda [119], as business modeling is facing the same challenges as agile requirement engineering and software development has been looking at for the past 10 years trying to increase speed and productivity [74].

- Changeability and modularity as ways to strategically address all new roles and values via choices to enable faster transitions from strategy to execution (operationalization) [P1, P3, P5, P6, P23, P25, P26, P27]. By systematically approaching the information management related to business models, changeability, and modularity, parts of the practices for business modeling may become automated as a solution to faster transitions.

- A growing need for multifaceted optimization of business models, as fueled by new roles and new values, as a contrast to the currently more dominant single dimension of cost and revenue [P2, P7, P8, P9, P26, P53], often leading to sub-optimal solutions. Such optimization will drive a need for more sophisticated decision support and higher levels of automation in the governance of business models and business model execution.
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We found no solutions or evidence related to multifaceted optimization of business models, while at the same time multiple studies highlighted the need for alignment of strategy and execution (daily operations). In combination with the two related trends of experimentation and changeability, we identified a common denominator in governance, as a foundation for faster and more transparent decision-support (for all roles in their interactions). Also, we found no systematic mechanism for organizational learning that potentially could minimize misunderstandings and improve decisions, even though organizational learning is important for successful BM [P9, P46].

We believe an important step towards such multifaceted optimization of business models lies in understanding how the business modeling practice connects to governance for evaluating effectiveness and efficiency of a company. We, therefore, propose CGM to facilitate the exploration of a governance framework for evaluating effectiveness (creating the right values) and efficiency (while using a minimum of resources).

6.6.2 A conceptual governance model (CGM) for exploring governance and evaluating effectiveness and efficiency of BM

We synthesized CGM for exploring governance and evaluating effectiveness and efficiency of BM. CGM is presented in Figure 6.5 and is inspired by Zott and Amit’s work on business models as activity systems that create value in transactions [175], and influenced by the theories of learning and knowledge creation by Pask and Nonaka [126, 112]. CGM links governance to BM via the antecedents (H1, H2), the business model (H3), real-world interactions (creating value and learning), and consequences (H4) as defined by Höflinger [72]. It is a conceptualization of the diversity of the problem of BM concerning value, effectiveness, and efficiency. We propose CGM be used for exploring experimentation in business modeling and designing a scalable IT solution. We believe the concept of ‘context frame’ and intent-driven systems [153] offers an exciting path forward and will be elaborated as part of our future work.

Figure 6.5 illustrates how the BM practice facilitates experimentation with a business model through a set of interactions between actors involved in the Define ($P_0$) and Execute ($P_1$) processes. $P_0$ and $P_1$ are abstracted from the underlying phases of interaction and learning, as mentioned both by Nonaka (dialogue vs. practice) and Pask (explaining vs. demonstrated understanding). The processes exist in a context, influencing and influenced by the environment on different abstraction levels (and each process can also be seen as a representation of an
Figure 6.5: CGM, a conceptual governance model for exploring effectiveness and efficiency in relation to BM with key relationships $r_x$

activity system with its interdependent activities in line with Zott and Amit’s work). Please note that both processes are highly context-specific, but always executed in pairs (as interactions of activity systems), e.g., context A = producing a strategy, context B = translating the same strategy into an operationalized business model in products. Therefore, $P_0$ and $P_1$ interact in a highly recursive, non-linear, interactive manner.

Depending on the context, different tasks and activities are executed (by sharing and modifying information related to various parts of the company’s strategies, organizations, policies, rules, and products in close relation to the ecosystem). Such context dependency is a critical and challenging factor for a process-centric implementation of activities since reuse easily becomes complex, unpredictable, and slow [84].

Governance is an abstraction of goals, measurements, follow-up, rules, knowledge, and insights. Relationships $r_1$ and $r_2$ represent the relationship between governance of Define and Execute processes and how governance is used to form an agreement (alignment of strategy and execution via goals, objectives, rules, measurements, and knowledge). $r_3$ represents the relationship between the Define and Execute processes and how governance is involved in tracking daily progress and facilitating alignment including change management (by executing in relation to the agreements established/updated via $r_1$ and $r_2$). $r_0$ is used to manage the effectiveness and efficiency of the BM process, while $r_4$ is used to control the outcome of the business (model execution). Our future work aims to develop these relationships into software interface in accordance with intent-driven systems [153].
Sustaining competitive advantage requires constant change [29]. Fundamental to this change is to understand the difference (make an Assessment) between the current position (Means) and the desired position (Ends). Successful change is thus a multifaceted function of alignment between Ends and Means, maintained by timely actions to modify Ends and the Means in response to the environmental influences and consequences. The purpose of the relationships $r_0 - r_4$ in Figure 6.5 is to manage successful change systematically. However, common to all studies (with quotes of purpose, Appendix A.4) is a lack of details describing the $r_1 - r_3$ relationships and how the alignment can be achieved and maintained.

The importance of aligning the execution with the strategy is specifically addressed by papers [P6, P32, P59] (without empirical results). Only Salgado et al. suggest solutions to how that could be done (methods and representation of information) [P59]. Ballon proposes an analytical framework and discuss how BM is interpreted as (re)configuration of control parameters (Combination of assets, Vertical integration, Customer ownership, Modularity, Distribution of intelligence, Interoperability) and value parameters (Cost sharing model, Revenue model, Revenue sharing model, Positioning, Customer involvement, Intended value) [P6]. Osterwalder et al. advocate formalization of business models to create traceability between business (the building plan) and execution (IS/IT systems) [P32]. Giessmann et al. extend Osterwalder et al.’s propositions to build a model that can analyze and compare business models, but their work does not address the issues of aligning and daily execution of a business model [P55]. Salgado et al. also build on Osterwalder’s BMC and discuss how to generate a BMC from business goals, rules, and processes, but do not further connect the results to the IS/IT realization and daily operations [P56]. They also discuss the alignment between business and IS/IT from the lens of business model artifacts, strategy and goal modeling, as well as enterprise modeling [P59]. They formulate the primary challenge as “Achieving alignment per se is not enough, organizations have to reach the alignment state and maintain it alongside its evolution”.

The quotes for challenges and benefits (Appendix A.4) also lack details describing the relationships $r_1 - r_3$ in Figure 6.5. Also, there are 62% more quotes than for purposes, which could be explained by that benefits and challenges are often more specific by nature than the corresponding purposes. The identified quotes indicate a more inhomogeneous nature regarding contextual settings, resulting in a scattered picture of benefits and challenges. We speculate this is a result of each paper framing their conclusions with some form of benefits or challenges, rather than constructing them from empirical findings.

The papers within the Governance column and Assessment row (see Appendix A.4) present important aspects of goals, rules, measurements, options, flexibility, and
knowledge. However, they do not propose solutions on how these concepts (with artifacts) should be represented or managed to create traceability to, and alignment with, the Define and Execute processes (via $r_1$, $r_2$, $r_3$) in Figure 6.5.

Six papers [P2, P22, P29, P32, P36, P54] cover all three columns (Define, Execute, and Governance), but no author elaborates on the relationships $r_1$ - $r_3$ (alignment of Define and Execute processes using Governance), see Table 6.3. Rohrbeck et al. study eight companies and discuss how collaborative BM can improve both Define and Execute processes [P2]. They report improvements in four areas (dealing with uncertainty, finding creative solutions, facilitating a strategic discussion, and allowed to start the innovation planning), but provide little details or empirical evidence as to how well it works. Baden-Fuller & Morgan scan the literature and discuss business models as models, describing their multivalent character and the wide range of usage [P22]. They conclude “Business models are not recipes or scientific models or scale and role models... they play any – or all – these roles, often at the same time”. Osterwalder et al. propose eight propositions for BM that need to be tested [P32]. Zott et al. in their review six years later reveal that scholars still do not agree and that literature is developing in silos [P29]. Cortimiglia et al. explore, in a large empirical-based investigation, the relationship between the strategy making process and business model innovation (BMI) [P36]. They summarize a large number of purposes found in literature, which also matches the improvement areas we have identified, see section 6.5.1. Their findings validate the role of Business Model Innovation as a valuable tool for, and link, between strategy execution and operationalization. Meier & Bosslau, in their case study, propose an integrated design and engineering approach as an iterative learning process based on system dynamics. They conclude that further development of modeling and simulation that depicts the dynamics and flexibility in the whole life-cycle is one of the key challenges for business model research (in a context of Industrial Product Service Systems) [P54].

6.7 Implications for research and practitioners

The results suggest that business model (and BM) is a diverse research area which would benefit from more aggregation efforts [P29, P40, P3, P9] on how business models could address the vast set of purposes and practices for BM, and what effects BM have on effectiveness and efficiency of a company. More work is needed to consolidate these different angles of the business model construct into a scalable, practically useful representations that will facilitate innovation, experimentation, and operationalization of the business model. The lack of coherence
is more recently investigated by Massa et al. [102], as they identify possible reasons for the current lack of agreement in literature as terms and concepts slowly morph over time.

In the same vein (seen from a practitioners’ side), Gartner\footnote{Gartner Identifies Six Key Steps to Build a Successful Digital Business, 2014 https://www.gartner.com/newsroom/id/2745517} points out that “digital business should not be considered an IT program and should instead become an enterprise mindset and lingua franca, with digital expertise spread across the enterprise and value ecosystem”.

Our results confirm the above and highlight a challenging issue for effectively and efficiently defining contexts to improve understanding and communication in BM literature. We also note a potentially strong correlation between flexibility, effectiveness, and efficiency (all 13 papers addressing RQ2 also address aspects of flexibility and variability in the realization, IC2 and IC3, see Table 6.2).

We recommend the following topics to be added to a cross-disciplinary agenda for BM:

- Further exploring how contextual information in the business model construct could be systematically represented, structured, and stored. The improved representation of contextual information is going to increase effectiveness and efficiency when creating, modifying, and deleting information needed to transform strategies into tactics and daily execution, e.g., facilitating business model choices, including a residual set of choices related to tactics, and deciding on choices controlling daily interactions between stakeholders (as controlled by a set of configuration parameters and rules in software applications). A business model construct must support collaborative and role-based interaction, including exchange and interpretation of contextual information, scalable to thousands of actors, and across corporate borders. We believe intent-driven systems [153] could be a way forward for this purpose.

- Connecting the BM practice with Learning Theory would help to create a model that can help explain: 1) how value creation and stakeholder motivation is derived from, and connected to, daily interactions; 2) how daily interactions, in combination with organizational learning, shape the transformation of strategy into execution; and 3) how organizational learning influences the process of BM. These aspects become increasingly important since experimentation with value co-creation and business models are gaining interests [P2, P9, P13, P18]. This implies BM to be involved, not only in strategy and planning but also in the operationalization and follow-up
of the business model, as the focus of a business model is shifting beyond the company borders into the ecosystem.

The implications for industry originate mainly from the lack of tangible results linking efficient BM to efficient and effective businesses. We recommend managers to investigate and build awareness of the following aspects:

- Systematically converting experience into knowledge will help the organization identifying and verbalizing (new) values and motivators relevant to the business. Investigate how to incorporate organizational learning (OL) [6] into everyday practices and business processes to support experimentation with business models, e.g., what is the current level of OL? How is OL incorporated into important business processes? Which roles are currently not involved in structured OL? How is OL related to the fulfillment of goals, an organization’s creativity and motivation, and incentives?

- Critical components in any SIPD business model are concepts such as value co-creation, collaborative value networks, and acquiring resources beyond the control of the company (i.e., creating an ecosystem of partners and customers). How to prepare a company’s staff and products to these concepts? How do you facilitate similar activities for your partners? These ideas will affect the products and offerings but also fundamentally change most aspects of a company’s policies and business processes including incentive structures and management systems (e.g., sharing of information internally/externally and risk management). We believe the introduction of a value vocabulary, to facilitate more precise understanding and definitions of business-critical concepts, is a concrete and valuable first step, e.g., SVM [80].

- What factors hinder business model experimentation? What level of business flexibility is required (and used)? How is that flexibility implemented in the products, organization, business processes, and management systems? The value creation process is highly interdependent and not well suited for isolated practices [P14, P15, P30]. Business modeling could become a tool to bridge these practices [P2] and SIPD companies should not see software architectures and methods as costs. It’s a significant investment that facilitates experimentation while adding to the value creation. Such investments in business flexibility will become a crucial source of innovation and an enabler for automating business processes, resulting in an increased efficiency and competitive advantage.

- A governance mechanism is a critical element to build a commitment to experimentation and the development of the appropriate business flexibility. The mechanism should support multi-contextual governance views,
maintaining traceability between all choices (strategical, tactical, and operational) and the views must be based on data from different contextual situations (narrative, planning, development, daily operational tasks, phase out, etc.) [153].

6.8 Conclusions

This systematic literature review explores the purpose of business modeling and its impact on effectiveness and efficiency of a company’s business. Most companies invest in business modeling, but remain uncertain whether their investments allow them to change and adapt their business fast enough.

Our results show that the reported benefits are unsubstantiated or claimed with limited empirical evidence and the challenges are dispersed. The most common challenge is how to deal with the dynamics of business models, and most of the quotes on challenges relate to the non-existing solutions for governance (representation, simulation, decision-support, and feedback) of the proposed frameworks and methods.

The improvements associated with efficiency and effectiveness of BM are neither substantiated by empirical evidence nor grounded in empirical data. Given the diverse contextual settings in the studies and the dependence of the BM approach, it remains an open question whether the application of any of the identified practices results in increased or decreased efficiency or effectiveness for a company’s business. Any outcome variations may simply be a result of fluctuating contextual or environmental factors rather than the application of a BM method or technique.

We concur with Zott et al. that “literature is developing largely in silos, according to the phenomena of interest to the respective researcher” [174]. Since the influential work by Osterwalder et al. on business models [121], which later gained a lot of interest among practitioners, researchers are still reporting that business models and BM is a diverse research area missing an agreed definition of business model. It is an area that would benefit from more aggregated cross-disciplinary research results [119, 102].

Supported by our results, we argue that;

- related to RQ1, what makes business model research results challenging to analyze, compare, and combine is the lack of a systematic approach in

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8Originally called the Business Model Generator in 2010, now changed into a commercial product https://strategyzer.com/canvas
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describing the contextual information used to define the context for a specific business model construct and business modeling practice. The lack of systematic contextual information leads to inefficient communication, knowledge creation, and organizational learning, which affects the quality of decisions (on all levels). A consequence for business modeling is misalignment between the business model and its realization, which negatively affects the value creation (effectiveness) and the efficiency. By improving the information management parts of these processes, tasks may become automated, opening up for new ways of specifying and visualizing strategies, goals, and operational consequences, as related to effectiveness and efficiency.

• related to RQ2, we conclude that governance is going to gain importance, as it must effectively support a chain of continuous adaptations and learning (experimenting). Such governance can enforce a continuous (business model) design aligned with the continuous (business model) execution. We further argue that governance is the primary challenge for business modeling, and that (continuous) business modeling can be used (via governance) to effectively and efficiently cope with change, by connecting the definition of strategy to the execution of operations in daily decisions and activities as depicted in Figure 6.5.

• by combining above conclusions, that the lack of a rigorous, scalable, context-dependent (software and IT) representation of the business model, in combination with efficient governance mechanisms (to manage needed flexibility), are currently significant obstacles for progressing the research area and supporting the industry in managing innovation in co-creation-driven (software-intensive) business ecosystems.

We, therefore, believe our conceptual governance model is a significant step to explore and identify how the business modeling practice could become an integrated cornerstone in a more effective and efficient software-intensive product development enterprise. Our conceptual governance model can facilitate the creation a common business model construct including mechanisms to support effective and efficient governance with value-based decision-support for all affected roles and stakeholders.

Also, we believe our extensive, cross-disciplinary review of the business model literature, seen from the perspective of software and software-intensive products, is a valuable contribution for the Software Engineering community when trying to address the digitalization’s effects on software engineering and software product development.

Our next steps in our research towards efficient and effective business modeling
are to use our proposed conceptual model to identify essential characteristics of a governance framework and a scalable business model construct, as required to facilitates effective and efficient operationalization of a business model. We will also verify the conceptual model with practitioners to ensure that our results can be disseminated by industry.

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Chapter 7

Business modeling and flexibility in software-intensive product development

Magnus Wilson, Krzysztof Wnuk

Abstract

Continuously achieving and maintaining competitive advantage is the critical survival factor for software-intensive product development companies undergoing digitalization transformation. These companies remain uncertain if investments in business modeling is sufficient to cope with rapidly changing business models, technology, and customer demands. We conducted a Systematic Literature Review using the snowballing methodology to explore the effects of business modeling on business flexibility and variability in the realization. Our results confirm a research gap regarding translating desired strategic flexibility into business options that can efficiently and effectively be implemented using software-based variability in the realization. We conclude that more research is needed consolidating business model innovation, experimentation, and operationalization. Building on theories for learning and knowledge creation, we propose a framework
for describing change and analyzing strategic, tactical and operational choices in business model experimentation.
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7.1 Introduction

The inherently flexible nature of software fuels the ongoing digitalization transformation as it allows for rapid changes and adaptations in delivering value to the customers as a response to technology innovation and new business opportunities [103, 14]. A business model helps to manage and innovate the business toward value creation for all stakeholders [175], by supporting the choices and consequences of these choices in products, business processes, and organizations [29]. Optimizing value creation requires profound understanding of how the implemented business model interacts with products and stakeholders [92].

Software-intensive product development (SIPD) companies have a unique position for efficiently creating value appreciated by all stakeholders. Software is the main component in 1) the tools for implementing and supporting core business processes; 2) developing the software product itself, and; 3) integrating the product into the business ecosystem. SIPD companies adapt and integrate their software to the desired business model using business modeling [121].

Business modeling (BM) aims to analyze the business environment and drive change, by adapting and aligning the business strategy with the execution, to create value for all stakeholders [56, 72]. The literature suggests experimentation [36], collaboration [138], or trial-and-error learning [156] to deal with business model change. The speed of changes in the software business demands increased flexibility between strategy, implementation, and the business model execution [14].

Several prominent authors emphasized the lack of coherence and a clear focus in the business model research [102, 72, 86, 174]. In particular, there is a gap in understanding how business modeling interacts with the digital business strategy, and what effects business modeling have regarding selecting, developing, deploying, and monitoring the optimal set of business choices in software products.

This study investigates how flexibility is linked to business modeling for SIPD companies, and if business modeling can bridge the gap between managing business choices and developing variability in the business model realization. Based on the literature review results, we present a summary of the benefits and challenges associated with BM, including reported connections to the flexibility of the business. Next, we synthesize the findings, list trends for BM, and propose a framework to describe change based on changeability and contextual dimensions.
7.2 Background and related work

We base our work on the BM definition by Rohrbeck et al. as “to be a creative and inventive activity that involves experimenting with content, structure, and governance of transactions that are designed to create and capture value” [137]. Rohrbeck et al.’s definition supports our investigation of BM for SPID companies in two ways. Firstly, looking at a transaction that creates value as the unit of analysis for a business model [175], it allows for a value-driven business model analysis. Secondly, by introducing the word *experimenting*, it extends BM to a process of ‘translating an idea into execution, test, and change until satisfied,’ similar to the agile method of developing software products. However, experimentation requires fast feedback loops between business model planning and execution, so we complement the BM definition with the proposed capabilities needed for BM (Understand and share, Analyze, Manage, and Prospect) [121].

The term *flexibility* is introduced in different contexts, e.g., strategic flexibility, business flexibility, as a way to managed change. Manufacturing literature suggests that building flexibility entails identifying uncertainty, implementing the appropriate decisions, and monitoring the achieved flexibility [21]. Flexibility in software business models is extensively discussed in literature, e.g., covering pure software business models [147], open source/mixed source [28] and digital options [145], transitions from product-based business models to service-based models [173], or to industrial product-service systems and use models [107, 105, 133].

**Strategic flexibility** (flexible reallocation of resources, changing and adjusting plans and strategies, and maintaining options where needed) is an essential topic in business and management literature, e.g., [101, 148]. Business flexibility with the ambition to improve business performance is discussed by Manson et al.[101]. They proposed a model where business model flexibility is a function of the network structure, relationship typology and business model focus.

**Changeability** increases speed and agility by introducing flexibility of strategic choices supported by variability in the realization[133]. Changeability applies to software-based products, their design, production and delivery, and production. We believe that BM will go through a similar evolution as how agile software development changed the ways of working for software development companies (with always working software). Such an evolution will force BM to new representations of information and flexibility, and demand automation tools for effective and efficient planning and execution of business models.

**Variability in the realization** is discussed under the term Software Product
lines (SPL), with a focus on modular architectures and component structures. SPL emphasize creating a platform as a common code base, enabling product realization through variability and configuration management. Building a platform requires long-term investment and locks a company within a single solution for the commodity part of its products. A recent trend is to invest in software ecosystem participation, as a more efficient way of building and maintaining commodity parts of the products [17]. SPL literature mainly focuses on the technical aspects of product development and reuse, rather than business model flexibility.

7.3 Methodology

We considered software-intensive products as the unit of analysis and investigated the following research questions:

RQ1: What benefits and challenges are associated with flexibility in business modeling? We use RQ1 to investigate the contextual setting for business modeling and flexibility.

RQ2: What effects of business modeling related to business flexibility and variability in the realization are reported in the literature? RQ2 addresses how BM can support flexible business strategies and address the challenge of efficiently implementing the right flexibility in business options. This means deciding the right level of variability in realization.

7.3.1 The Snowball methodology

The Systematic Literature Review (SLR) methodology is based on the guidelines for snowballing literature search proposed by Wohlin [165], illustrated in Figure 6.2 and outlined in the four steps below.

STEP 1: Design of the literature review. We performed two open-ended interviews (60 minutes each) with an expert in Software Engineering (telecommunication industry with 25 years of experience) and Business management (professor in production management). We asked a question “Does business modeling enable improvements in effectiveness and efficiency for a company?” to understand the terminology and support creating inclusion criteria (IC) and data extraction properties. We also created a study protocol.

STEP 2: Defining the start set. From the two interviews, we received recommendations about four relevant papers. Next, we searched Google Scholar
to derive a collection of definitions and to develop the search strings (SS). We ended up with two search strings\(^1\). The search string is as follows:

SS1: (business modelling OR business model OR business ecosystem) AND value creation AND strategy

SS2: (“business modelling” OR “business modeling” OR “business ecosystem”) AND “business strategy” AND “value creation” AND (“effectiveness” OR “efficiency” OR “business flexibility” OR modularity OR “variability in realization” OR “governance” OR “multi-business”)

Executing SS1 and SS2 (limited to title-abstract-keywords) resulted in 2948 papers. The first author applied the inclusion criteria on titles and abstracts, removing 2378 papers. The remaining 570 papers were put in an excel sheet and duplicates were discarded. The final 477 papers were screened more thoroughly (abstract, introduction, conclusion) by the first and the second authors. We also included one paper [72] recommended by the expert in business management, giving us 10 papers in the start set.

**Step 3: Execute Snowballing iterations.** Each snowballing iteration started with the first author collecting the references and the citations for each selected paper and applying the exclusion criteria followed by the inclusion criteria. Google Scholar (GS) was used for citations [165]. We used Cohen’s Kappa in the different iterations for quality assessment, see section 7.3.2.

We screened 10414 citations and 2958 references in all snowballing iterations. Iteration 1 covered the start set and resulted in 35 selected studies (out of 612 references and 249 citations). Iteration 2 resulted in 2011 references and 10134 citations. Pre-screening (language, title, abbreviated abstract) gave us a remaining 1335 citations to screen. We selected 11 studies in iteration 2. Iteration 3 rendered 313 references and 30 citations, resulting in one new paper selected. Iteration 4 gave no further studies resulting in 57 studies selected for analysis, see Appendix A.1

**STEP 4: Data extraction, analysis, and synthesis.**

The data extraction properties (EP), see Appendix A.2 were designed and discussed before application. ATLAS Ti\(^2\) and Excel were used to keep track of and analyze results, and to synthesize extracted information.

\(^1\)SS1 uses stemming and SS2 doesn’t. Also, ”multi-business” was added upon recommendation of industry expert, since executing several business models in parallel is a significant challenge for large SIPD companies

\(^2\)Software for Qualitative Data Analysis, http://atlasti.com/
Properties EP1-EP4 were used to analyze the relevance to industry for each paper’s contribution. Property EP3 (Rigor & Relevance) was also used for quality assessment. It helped us to evaluate how generalizable the different results were, see section 7.3.2. Open coding [39] was used for properties EP5-EP9. The extracted data was thematically and narratively analyzed.

The results were iterated in two phases (a) RQ1 and (b) RQ2. For each phase, the first author prepared a summary of listed quotations from all studies. The list was then reviewed against the extracted result, and the first author had to explain a summary of each paper’s findings to the reviewer. Both phases were reviewed by the second author.

7.3.2 Validity threats

We adopted the validity guidelines suggested by Runeson [140]. We mitigated the industrial experience bias of the authors by conducting the two initial interviews and iterative refinement of the research questions and also by applying a grounded theory approach [39].

The selected ten papers in the start set are highly heterogeneous and therefore minimize the bias on specific author or terminology. Similarly, we mitigated the author’s bias by calculating the Kappa coefficient when selecting the start set papers. The first and the second authors did the Kappa analysis, and the value was $k=0.566$ and later $k=0.638$. The Kappa analysis was also performed on 12% of the studies from the first snowballing iteration with a result of $k=0.763$.

To mitigate author bias during extraction, six random studies were selected (of the 57 studies) and extracted by the first and second authors. The validation showed a discrepancy of one paper for extraction properties EP1-EP4 and after further discussion full agreement was reached. Also, the results to the RQs (EP5-EP9) was iterated in two phases, and each phase was presented by first author before discussed and evaluated by the second author.

Rigor and relevance analysis was applied and adjusted to mitigate potential threats to conclusion validity [75]. The relevance parameter was coded using binary weights (0,1,2, and 4 instead of the recommended 0 and 1). We also decided to add property EP4 to specifically address the relevance of a paper’s content concerning our RQs (since the property EP3 and its’ relevance aspects only consider the research method and context of a paper). This provided higher resolution when discussing the relevance and comparing the papers.

We minimized potential internal validity threats by following the systematic mapping study guidelines, creating a review protocol and sharing the work associated
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with data extraction and analysis. Because of the interdisciplinary nature of this study, the risk remains that some aspects are underrepresented and other aspects are overrepresented. In particular, business model innovation or business process modeling seems to be heavily researched in the business management and the computer science community. However, we decided to focus on the interplay between the strategic intentions, the design of a business model, the realization of it, and the resulting effects on efficiency and effectiveness, rather than details on how individual steps are performed. We addressed this by our choice of a snowballing methodology. We also used grounded theory approach with open coding [39] to harmonize language between the different research fields.

7.4 Results

7.4.1 Benefits and challenges associated with business modeling (RQ1)

We extracted 263 quotes of purpose, benefits, and challenges of business modeling from the identified 57 papers, see Appendix A.4. Quotes of purpose (P) often set the general context, while quotes of challenges (C) or benefits (B) often are a reflection of how well a solution to a specific problem works. We used open coding to thematically analyze these quotes into the following common areas: 1) Value creation/capture; 2) Assessment (decision control, clarity, visualization); 3) Mind-set and Knowledge; 4) Cost/Revenue; 5) Ends (Vision, goals, and objectives); and 6) Means (Mission, Strategy, Tactics, Directives, Resources)\(^3\). Also, we identified three primary contexts for BM: 1) Strategy & planning; 2) Daily operations (executing strategies and plans); and 3) Governance & communication.

The main purpose for BM is to stay competitive and improve business results. The quotes of purpose are often overlapping and cover a wide variety of more specific topics, like managing specific business aspects (e.g. offerings, market, cost, and revenue), capturing the business logic, over to a holistic nature like 'operationalize strategy', and 'appropriate value from technology'.

We analysed 90 quotes related to the 13 papers\(^4\) explicitly discussing RQ2 (business flexibility and the variability in the realization). Comparing these 90 quotes

\(^3\)We use the terms Assessment, Ends, and Means as defined by the Business Motivation Model Version 1.3 (BMM) by Object Management Group, http://www.omg.org/spec/BMM/

\(^4\)[P1]=[167], [P3]=[131], [P5]=[37], [P8]=[138], [P9]=[72], [P24]=[82], [P26]=[107], [P27]=[133], [P32]=[121], [P49]=[56], [P52]=[148], [P54]=[105], [P58]=[101]
with all 263 quotes, the strongest contextual coherence (Purpose, and Benefit or Challenge in the same primary context) is still found in 'Governance & communication', but significantly higher (45% vs. 26%). It is also interesting to note the shift of quotes from 'Strategy & planning' towards 'Daily Operations', and from 'Mind-set and Knowledge' towards 'Means'. We believe this is a natural consequence, as the purpose of flexibility is promptly respond to change. This would also be a reasonable explanation for why there are significantly more challenges (36) than benefits (8) reported for these 13 papers, indicating that solutions to achieve flexibility are still immature\(^5\).

The importance of contextual information is mentioned by seven studies [P8, P17, P18, P20, P25, P51, P59], but no author goes as far as to suggest how to describe the contextual information or represent the information. The underlying purpose reported in the studies is contextually vague, e.g., 'Deal with uncertainty', 'Meeting customers’ needs' [P2, P52, P54, P58].

Summarizing the most common challenge for papers explicitly discussing flexibility is how to deal with the dynamics of business models [P5, P9, P32, P49, P54, P58] and most of the quotes on challenges related to the non-existing solutions for governance (representation, simulation, assessment, decision-support, and feedback) of the proposed frameworks and methods. Since governance is not addressed, each individual method or framework may work in its’ specific context, but taken out of context or combined with other methods to form a solution for an enterprise, they fail to deliver the claimed benefits. The quotes of benefits are mostly unsubstantiated or claimed with limited empirical evidence.

### 7.4.2 Business modeling, business flexibility, and variability in realization (RQ2)

Looking at the 90 quotes found in the 13 papers explicitly discussing flexibility, we conclude that business flexibility is one of the core aspects in BM [P1, P3, P27, P52, P58]. Succeeding in managing business flexibility increases competitive advantages and performance [P58, P1]. It is essential to understand (and quantify) the value (and cost) of flexibility to optimize the value creation and capture [P27]. Governance (intra-company as well as inter-company) becomes the critical component to facilitate the design of the business model, and link the strategy to the execution of the business model by controlling and aligning the design and invocation of options [P24, P27, P32, P54, P1].

\(^5\)excluding the outlayer [P32] since it contains 25 claimed but unsubstantiated benefits and only 1 challenge
**Business flexibility as an option** is discussed in the different contextual settings, and on several abstraction levels [P1, P3, P27, P32, P58]. Reim et al. divide options into business model options (chosen and decided during the business strategy development), and tactical options (comprise all the choices after the business model has been selected) [P3]. Many of these tactical options (contract, marketing, network, and product design) are related to investing in software products and business processes, e.g., integrating new IT systems like Product-Services Systems (PSS).

Mason & Mousas goes one abstraction level deeper and starts by categorizing options as downstream and upstream relationships, discussing flexibility on three abstraction levels, network (identify), company (develop), and individual (use) [P58]. Upstream has a network-focus with options related to the business model architecture (transactional relationship, network influence, and corporate ownership) and tied to the realization of the business by choosing resources, partners, and channels. Downstream has a market-driven focus with options related to the business model focus (customer focus, competitor focus, inter-functional coordination) and tied to understanding the customer needs. Woodard et al. discuss options for digital business strategy by introducing the concepts of Design Capital (cumulative stock of designs owned by the company) and Design moves (discrete strategic actions to optimize the Design capital) [P1].

Richter et al. also advocate a modular design and discuss options regarding a system’s changeability (adaptability, agility, robustness, flexibility) by embedding flexibility early into system design [P27]. Flexibility must however not be an end in itself, but a conscious compromise between cost and benefit. Osterwalder et al. highlight the critical options managers make, when investing in IT for future strategic business agility, and speculate that business models play an essential role in facilitating such decisions [P32]. Neither of the studies proposes any details on how these concepts could be implemented in an industrial setting to facilitate flexibility with help of software.

**Increasing flexibility** is discussed in four papers [P3, P5, P8, P26]. Romero & Molina argue that collaborative networks and experience-centric networks can increase business flexibility and enable agility in dynamic and turbulent markets [P8]. By highlighting the value of co-creation and collaboration across multiple interactive channels, they illustrate how business flexibility can be addressed, but do not bring any further details as to how to manage the flexibility, nor how to measure it. Chew identifies service innovation, with a degree of service variability built into the services, as a way forward to exploit new technologies [P5]. Modularity, platforms, components, and interfaces are a foundation to meet the mass-customization requirements and become faster and more flexible. He concludes that service innovation and service architecture are not enough, but a
corresponding modular organization and IT architecture is also required.

Papers [P3, P24, P26] argue that combining products and services into Product-Service Systems (PSS) bridges business flexibility with the variability in the realization, and provides individualized, customer-oriented configurations and potential for mass-customization. However, PSS come with a new set of challenges (e.g., industrialization of service offerings) and are highly dependent on the continuous integration of large IT and software solutions into the life-cycle of the business model and organizations [P26].

Osterwalder et al. make propositions how the understanding of a business model, with all its business choices, facilitates and improves goals, the requirement engineering, and the choices of IS/IT infrastructure and applications will lead to more effective and efficient solutions [P32]. However, they do not discuss how the business flexibility is continuously transferred to flexibility in the realization and how these two are aligned.

Summary: Our identified studies offer only partial approaches and solutions (for BM) to manage the desired flexibility, and to facilitate pivoting in response to disruptive changes in the realization of the business model, e.g., products, organizations, processes, contracts, governance.

Choosing the right options and governance is discussed by seven papers [P1, P24, P27, P32, P49, P54, P58]. Kindström argues that understanding business flexibility is a critical aspect, during the service-based model transition. However, he provides no details and concludes that further research is needed how to industrialize service offering to a larger scale, and how to deal with variability in realization [P24]. Richter et al. discuss flexibility in the context of uncertainty, contracts in use-oriented business models, and IPSS [P27]. They perceive flexibility as the ability to react to changes, and suggest a method to determine the value of flexibility. They discuss 1) Real options for accessing flexibility and 2) Net options value of modularity in the design, and conclude with the need for future research on a combined view on the design of an IPSS and business models. They stress a focus on the IPSS design with the inter-company governance structure, since choosing the right flexibility, is crucial controlling parameter when optimizing value in an IPSS. Similarly, Woodard et al. recommend using a two-dimensional structure of real options and technical debt to facilitate decision-making on options [P1].

Eurich et al. propose a six-step approach to business model innovation based on ‘network thinking’ [P49], to overcome the tendency of focusing on model-internal consistency rather than the specific business situation. They argue that in a component-based structure, flexibility and explanatory power are lost, due to the abundant relationships, and often inexplicit dependencies between compo-
ments and the dynamics of the environment. A vital part of the approach is to understand relevant choices, to make the options explicit, and to visualize relationships between these options. They do not detail how to manage flexibility from all these options and aspects but do recognize governance and early detection as shortcomings. Salgado et al. proposes a framework based on processes, goals, and rules to facilitate and visualize the desired flexibility on IT systems, but conclude their solution needs much research to become robust and scale to industrial settings [P56].

Meier & Bosslau argue that there is almost no attention in research to the dynamic aspects of business models (flexibility, validation, and implementation) [P54]. They propose a learning feedback system that integrates business model engineering and design, to transfer insights via a ‘business model cockpit’ back into business model innovation or re-design. They suggest using System Dynamics and diagnostic simulations as a continuous design, validation and implementation of business models, but offer no empirical evidence on the effectiveness or efficiency of their solution.

7.5 Discussion

As Schneider & Spieth pointed out, the literature provides little evidence that business model innovation does improve dynamic capabilities and strategic flexibility [P52]. They also recommend future research to measure strategic flexibility. Our review confirms their viewpoint regarding flexibility and we argue that efficient governance mechanisms focusing on continuously managing consistency and traceability of options, need to be built into both business and software architectures, to contentiously create and manage the required variability in realization. We also believe the concept of changeability as forwarded by Richter et al. [P27], implemented with a governance mechanism between business and software architecture, can play a pivotal role for the operationalization of flexible business models.

Supported by our results [P26, P27, P49, P54], we argue that variability in the realization is an important, but often overlooked aspect of business flexibility which must be an integrated part in the BM analysis and design phases. Business complexity and variability in realization should form a synergy and support conscious investments decision in technology and organization [131]. This puts SIPD companies in a unique position to invest in an optimal flexibility and software architecture for the business model realization. Constraining factors like speed, time-to-market, cost and automation levels, can be solved by software investments in any combination of the three aspects 1) tools for core business processes, 2)
the development of SW products itself, and 3) integration of the product into the ecosystem. From the results, we synthesized the following trends:

- experimentation and operationalization of flexible business models to manage the speed of change fueled by the digitalization of the value delivery [P1, P2, P9, P13, P15, P18, P49]
- changeability and modularity as ways to strategically address all new roles and values via choices to enable faster transitions from strategy to execution [P1, P3, P5, P6, P23, P25, P26, P27]
- need for multifaceted optimization of business models, as fueled by new roles and new values, complementing the more dominant single dimension of cost and revenue [P2, P7, P8, P9, P26, P53]

Our results also reveal an underlying issue of inhomogeneous, non-systematic, contextual descriptions. The importance of “The parts are not the Whole” is argued by Osterwalder et al. [P32] and conclude their paper with “One of the shortcomings in business model literature is that the different authors rarely build on each other. Consequently, business model research as a whole advance more slowly than it could and often stays at a superficial level”. Six years later Zott et al. still argue the same [P29], and after an additional three years, Höflinger reaches similar conclusions [P9]. He proposes the following further research directions: 1) further investigation of the business model concept itself, especially with regard to the coherence of the three underlying structures and their interdependencies; 2) considering the dynamics of business model change and innovation requires establishing governance mechanisms to facilitate feedback loops between planning and execution. The first step towards establishing such governance is to understand how change impacts existing business model realization, i.e., describe and document change, so all aspects related to this change can be addressed in the realization (organizations, rules, and IT systems). We illustrate this with an example of introducing a new feature in a product at a large organization to improve their agility and decrease time to market by 50%. The initial requirement engineering work by the R&D department resulted in the estimated effort of 2200 person hours. Later, this estimate exploded into a chain of business models and organizational changes affecting own staff, partners, processes, IT systems, changed policies in marketing and advertisement, as well as to change how the product is sold and who should sell it. The total change was estimated to 43 000 man-hours over a period of 7 months.

Since the full consequences of a change are greatly unknown until the change is fully implemented, the change often triggers several new changes. The change life-cycle is related to the realization life-cycle, and if new changes occur in already decided changes that are still not (fully) implemented, a rippling effect and
propagation of new changes happen, rendering impacts and consequences hard to manage. Therefore, if the speed of changes is faster than the time to implement all changes, a gap grows. As a consequence, the initial business intent might not be fulfilled.

Inspired by the conversation theory by Pask et al. and the knowledge creation process in a business context [153], we speculate that this process of change, when integrated with the process of organizational learning, enables experimentation for a company (rapid and controlled transitions from idea to realization). The need for learning and knowledge transfer is also highlighted by Mason & Leek to handle dynamic business models [P46].

We, therefore, argue the necessity for having better contextual descriptions of a business model construct. Inspired by the aspects of changeability and ideas presented by Richter et al. on flexibility for use-oriented business models and value-based design [P27], we propose a framework describing and documenting change by four changeability aspects (rows) and five contextual dimensions (columns), see Figure 7.1. The white oval indicates a change that is introduced, e.g. a new product that requires new functions in marketing (=‘business function’) to reduce time-to-market by 50% (=‘agility’).

The key characteristic for this framework is to support experimentation and learning while maintaining a practical and efficient level of control (over change) [P9, P15, P18, P22, P36, P51]. That helps an organization to describe how a change propagates and influences the other aspects of changeability and contextual dimensions. Each element in the matrix contains one or several artifacts that are linked and related to real information used in companies. To remain consistent, each matrix element needs to be kept internally, vertically, and horizontally (IVH dimensions) consistent. For each change, the process of maintaining consistency needs to be repeated over the IVH dimensions. Hence axiomatization and efficient information representations are important.

To address the speed of changes challenge, we introduce the ‘Right-time binding’ concept, defined as a flexibility management function optimized for multidimensional value. Right-time binding allows the invocation of specific options (i.e., choices related to particular change descriptions) to allow runtime decisions rather than during system design. Such flexibility does come at a price [P27], and Right-time binding becomes a vital part of the governance mechanisms to simulate and visualize consequences of choices (i.e., changes). It needs to be integrated into the governance mechanisms, the business architecture as well as the software architecture, acting as a bridge between the business model (strategy) and the operationalized business model (execution).
7.6 Conclusions

This systematic literature review explores business modeling and flexibility within the lens of software-intensive product development. Digitalization of software business fuels the diversity of strategic, tactical, and operational choices [5] during efficient business model realizations. The literature provides little evidence that business model innovation utilizes changes to dynamic capabilities to improve strategic flexibility, and our review confirms this viewpoint regarding flexibility. We argue that efficient governance mechanisms focused on continuously managing consistency and traceability of options, need to be built into both the business architecture and the software architecture. Business modeling, supported by efficient information management tools, could become the bridge between the investments in software-enabled variability and the desired strategic flexibility. As the next step, we propose a framework for describing and analyzing change, based on changeability and contextual dimensions.

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Chapter 8

Towards Multi-context Goal Modeling and Analysis with the Help of Intents

Magnus Wilson, Krzysztof Wnuk

Abstract

This vision paper discusses the need for enriching goal modeling with intents and context frame to provide much richer contextual information over goals and realization strategies. Based on the extensive experience of business modeling at Ericsson and a review of current goal modeling approaches, we suggest possible research directions towards enriching goal modeling.
8.1 Introduction

Goal modeling is an important part of Requirements Engineering, and several researchers focused on developing goal-modeling notations and methods [79]. *i* [169] and KAOS [90] are the two most widely recognized goal modeling frameworks. Goal modeling support understanding why and support early-phases of requirements engineering, reason about non-functional aspects [38], modeling strategic relationships and social aspects [170] or dependencies between actors and their goals. However, goals do not capture the rich contextual information, the knowledge of the actors who specify them and the actors who receive and interpret them.

Another limitation is the limited support to capture the temporal nature of goals and their changeability over time. Although *i* Strategic Rationale (SR) models can be used to show the internal intentional structures of actors, significant changes over time to the goals or actors usually result in creating new goal models. Despite some promising work on combining goal modeling (with *i*) and decision modeling [124], documenting rich contextual information, role and knowledge of the actors remains an area that is greatly unexplored.

This paper builds on theories (1) for how interaction between two parties create knowledge and understanding [126, 112], and (2) establishing the foundation for value creation through the intent via promises and agreements [12]. We present the result of extensive analysis of goal modeling principles and approaches performed by Ericsson AB and highlight the shortcoming and additional aspects that should be considered to increase the probability of industrial application of goal modeling.

We postulate that goal modeling should be enriched by intents (which are the state of mind with which an act is done\(^1\)) expressed by context frames (as the total domain information for the specific domain an actor has obtained) [153]. Intents and context frames can provide a much richer and much-requested view of goals and realization strategies.

8.2 Related Work about Goal Modeling and Conversation Theory

Understanding (business) goals and the associated intended value creation is an essential part of goal modeling. The business goals are derived from the busi-

\(^1\)By Merriam-Webster, https://www.merriam-webster.com/dictionary/intent
ness owner’s intentions, which may vary over time. The value creation process aggregates the result of many interactions between actors, each based on complex relationships between the actor’s needs, wants, knowledge, skills, and the contextual situation (role plus environment) [175, 92].

In this work, intent is defined as a subject or type of possible behavior, i.e. something that can be interpreted to have significance [12]. Any actor can have intents. We define an intent-driven system as a compositional system of human actors and machine actors. The machine actors are software agents where the agents declare, negotiate, and assess intents made by agents. The intents can be declared, negotiated, or assessed, on-behalf of an agent’s stakeholder or an agent’s self-interest. Intent-driven systems capture stakeholders’ intents in the form of business requirements or capabilities and transform these intents into a form that enables computer processing of them [153]. This view is similar to the Belief-Desire-Intention (BDI) where human and computer agents are capable or rational behavior [129]. BDI recognizes the dynamics of contextual changes and different ways that agents and systems can respond to these changes. BDI also recognizes that a single agent has no possibility to capture all contextual changes, supporting our suggestions to introducing context frames and unified contextual information representation that can be shared between the agents.

Business models and business modeling are used to develop a greater understanding for the business and its’ environment (context of the interactions). Business models capture the business goals, as connected to customers and partners, but also the underlying business logic, and how resources are configured to generate profit through transactions and interactions. The business model literature introduce three essential views for analyzing business goals: top-down [72], bottom-up [175], and inside-out [119, 118].

**8.2.1 Results of the analysis done at Ericsson**

By using Pask’s conversation theory as a model for learning [126] and Nonaka et al. theory on dynamic knowledge creation [112] applicable to actors in a group, we can further elaborate on the details of intent and the temporal effects for an actor in an interaction. The two specific scenarios benefiting from this type of analysis apply to goal modeling.

- **Scenario 1 (Define)** deals with the interpretation and (mis-)understanding of the business goal between the two actors involved in goal modeling
- **Scenario 2 (Execute)** deals with the contents of the business analysis (value, products, stakeholders, business processes) and the definition of the busi-
ness goal itself.

This work focuses primarily on Scenario 1, but also tackles Scenario 2, as the realization of any goal is done through a series of interactions in transactions. For efficient goal modeling, we postulate the importance of separating roles, contexts, and temporal effects in the models, and to be able to generate role-dependent views out of shared knowledge and information with the aid of efficient information management tools[153]. Our work is related to agent oriented software systems suggested by the Tropos methodology [23, 31], but highlight the importance of documenting and exchanging contextual information between the agents and/or actors.

Höflinger’s conceptual framework of the Business model’s antecedents and consequences see Figure 8.1, combined with the dynamics of interactions and learning provides us with a theoretical foundation to understand the interactions that take place to fulfill individual business goals (scenario 2). Combined with the activity system view by Zott et al. Figure 8.2 serves to explain the temporal aspects of goal evolution, derived from an individual actor’s intent, knowledge, skills, and learning.

Each action performed on any of Höflinger’s sub-component results in reactions (and changes) in other sub-components that can cascade and can cause potential misalignments of the business model (H3) and its consequences (H4). The arrows in Figure 8.1 depict such continuous, multi-relationship influence as a process of change, which in turn is the consequence of a multitude of interactions (IV) on different abstraction levels in combination with organizational learning (LV).

Examples of abstraction levels are company level (value), organizational level (function/capability), and individual level (task/ability to execute) which are also identified by Mason & Mouzas where they also discuss how flexibility is developed to re-enable alignment (in and between layers)[101].

These three abstraction levels also map to the top-down, inside-out, and bottom-up approach of business models as per our references. Business modeling can, therefore, be seen as a highly iterative and recursive process of experimentation, knowledge creation, and learning, toggling between the critical states of dialogue and practice [112] or as conversation theory explains how learning is created, through repeated cycles of explanation and demonstrated understanding [126].
Figure 8.1: Goal modeling as a linear flow based on Höflinger’s conceptual business model framework
8.2.2 Interactions, transactions and business goals

To explore how (and when) these transaction and interactions relate to the business goals and how different actors interpret, react, and (as an organization) learn from the outcome of the interaction, we add conceptualizations for Interaction (IV) and Learning (LV), see Figure 8.2.

The Interaction view (IV) in Figure 8.2 illustrates interactions between two actors and helps to explore the complex relationships and causalities between (sub)-components (H1-H4), see Figure 8.1. An internal actor (RI) interacts with an external actor (RE) using an agreed language (L) related to the domain D (=D1+D2). Domain D1 is defined by the boundaries and constraints stemming from internal antecedents (H1) and the business model (H3) with the relation to RI. Domain D2 is derived from external antecedents (H2) and the business model (H3) in relation to RE. Both D1 and D2 are also part of a larger domain which shares many similarities with the “Ba” concept in the Knowledge creation process [111].

The internal and external actors in the interaction view (IV) may have different intents and slightly different interpretation of the shared domain D, in which the interaction takes place. RI and RE are described by the resource structure (H3.2). If RE is a customer, additional descriptions are found in market opportunities (H2.1) and the value structure (H3.1), see Figure 8.1.
The context of the interaction is described by the transactive structure (H3.3) in relation to resources and skills described in the resource structure (H3.2). The result of an interaction is therefore dependent, not only on the domain (Ba), but also connected to the dynamics between individual actors, i.e., need’s fulfillment, value creation (guided by understanding), and learning. Domain knowledge and cross-functional communication plays the key role in these interactions [44].

The language L in Figure 8.2 can also be seen as a representation of the offer and contractual agreements derived from the value structure (H3.1). A goal for the interaction is to satisfy the needs of RE thereby creating a perceived value, optimally matching an offer (one or several anticipated values) as designed in the value structure (H3.1). By using an optimal configuration of value and control parameters (detailed by H1.1, H1.3, H3.1, H3.2, and H3.3) the intended consequences (H4) are also fulfilled for the company (represented by RI).

The consequences (H4) are divided into four key aspects where superior performance (H4.1) and financial value (H4.2) are the obvious intended consequences of a business model. Höflinger differentiates between financial value (H4.2) and social value (H4.3) while our previous work on Software Value map [80] explores additional essential value aspects and for example, translates organizational learning (H4.4) into explicit innovation and intellectual capital values. Organizational learning (H4.4) can be seen as a feedback loop and how an organization develops knowledge to maintain superior performance and to create/rejuvenate innovative business models for the longer term via systematic business model innovation.

Learning (LV) in Figure 8.2 is added to explore the organizational learning and the dynamics of why and when there might arise a misalignment between reality and the intended consequences, as shaped in any interaction by original intents, skills, new understandings, and learning.

Learning (LV) in Figure 8.2 illustrates how knowledge is created in a conversation as a consequence of reaching strict understanding between two actors A1V and A2V, who has agreed in a contract to follow the rules of a language L valid in the domain D according to Promise Theory [12]. Their respective understanding of D does not need to be the same, hence slightly different domains (D1, D2) in which a translation, interpretation, and exemplification to demonstrate understanding takes place (which may involve more actors/machines in forward and backward feedback loops, as illustrated by the languages L1’, L1”, L2’, L2” and A1E, A2E). This model highlights the importance of requirements negotiation and communication and roles like information brokers may be essential here [99].

By reaching an understanding, knowledge is created and represented by topics
becoming commonly known (and added to D). Actor A1V continues to explain until A2V illustrates understanding by exemplification and strict understanding is reached. This is a 2-phase process (Define and Execute) that involves toggling between definitions and concretization by exemplification. Applying such mechanism on the Interaction (IV), RI can be abstracted to a chain of actors, and if strict understanding is not reached, potential misalignment is introduced and will cascade with every interaction.

For scenario 1, an example of actors could be Product Manager (RI) trying to agree and align with the design suggested by the chief architect (RE) and discussing what goals to develop and how they impact the current business and business processes. For scenario 2, we simply replace the actors towards a company (RI) and a customer (RE), and the same mechanism applies on a different abstraction level, but in a much more complex environment due to the size and complexity of the whole value creation and value capture.

8.2.3 Problem statement

In today’s digital business transformation [103, 14], we argue that the feedback loops must be supported by efficient role-based information management tools that can be efficiently and transparently used by all actors collaborating in the value capture and value creation activities. Given today’s methods in RE, including goal modeling, the modeling methods and tools are not fast enough to allow all actors to collaborate efficiently to realize the business goals. As a consequence, Ericsson is actively looking into new ways of modeling (and information management tools) to maintain the scale and speed of change, with a predictable level of quality, as one strategy to manage the digital business transformation².

8.3 Enhancing goals with intents

We believe goal modeling would benefit from the richer notion of changing business intents [153] by understanding how changing business intents evolve through interactions, see Figure 8.3. By looking how vision, mission, strategies, goals, tactics, and assessments relate to policies and rules (encoded knowledge) [116] and combining this with the Business Model Canvas [118], we define a conceptual

²Seen from an industry view, please watch this talk by Simon Wardley as an anecdotal introduction to the challenges of translating strategies into successful businesses, https://youtu.be/xlNYy8pzB4
model for what actor information is important to capture and share between other actors in different domains.

To achieve scalable and an abstraction-less information representation, we also define the **context frame** as "as the total domain information for the specific domain an actor has obtained" with the metamodel in Figure 8.4 [153]. The compositional context frame sits in the middle of the changing business intent’s lifecycle, and via the concept of Governance views, all necessary information can be accessed and shared with all stakeholders in their interactions (on any abstraction level), see Figure 8.3. We also speculate that Digital Business modeling\(^3\) will become a fusion of existing RE, Software Product lines, and business modeling, in the same way as Digital strategy has become a fusion of business and IT strategy [14] as result of the new digital business where software become a vital part of products, business processes, and other tools for any company.

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\(^3\)Seen from an industry view, please read this SAP white paper as a brief introduction to Digital business modeling and the challenges for efficient and effective information management, https://tinyurl.com/y77kg38m
8.4 Implications for research and practice

One of the main implications from our work is the lack of fast feedback loops between the definition phase and the execution phase. We have also found no information representation that will allow for contextual negotiation between actors to accommodate an alignment and feedback of anticipated (designed) and perceived value (via a contract). We believe such a mechanism to be crucial for enabling an experimental, collaborative business environment and ecosystem.

We believe that will soon see an explosion in ‘smart agents’, where human actors will be supported by software agents acting on their behalf, observing, interpreting, negotiating, deciding and fulfilling their intents based on available information and continuous learning. Of course, machine-learning, block-chains, and other technologies will be an integral part of such intent-driven systems, bringing challenges within transparency, privacy, security, legal accountability.

We believe that intent-driven systems based on context frames will create a new architectural style based on near real-time flexible governance views. Together with a new set of interfaces, software agents should be able to help humans manage changing business intents. For example, software agents can help part of our business processes become automated while adapted to understand and negotiate intents into promises and contracts, which can be acted upon. Software agents can also be built into the business, enterprise, and product software architectures, as the time between changing the business model until the new business model is operationalized will continue to decrease, while the required information that needs to be kept consistent is increasing as well as becoming decentralized.
Chapter 9

The implications of digitalization on business model change

Magnus Wilson, Krzysztof Wnuk, Lars Bengtsson

Abstract

Many software-intensive product development companies are still struggling with the alignment of business and technology changes to find an optimal balance between products and services while remaining agile, effective, and efficient. Business model alignment is highlighted as a new business model research area for understanding the relationships between the dynamic nature of business models, organization design, and the value creation in the business model activities.

In this paper, we synthesize the impact of digitalization on business model change for the software-intensive product development industry. Based on established theories, we link effectiveness and efficiency, to value creation in business model activities and organizational learning, in a step towards conceptualizing business model change as a significant part of developing software architectural support for a business model change in a learning organization.

Our unit of analysis is the value created in a transaction between two actors
in a business model activity, and how that value is supporting transforming a capability into an efficient ability. Based on our results and to facilitate the cross-disciplinary analysis of business model dynamics, we present seven propositions and a conceptual model linking effectiveness, efficiency, value, transaction, and organizational learning to business model change via the value membrane.

**Keywords:** business flexibility, digital business modeling, equivocality, knowledge creation, knowledge management, intent-driven systems, learning organization, value capture, value creation, value membrane
9.1 Introduction

This paper discusses the implications of digitalization and servitization on the transactional nature of business models [91] based on an extensive literature survey and a longitudinal case study at Ericsson, as an example of a software-intensive product development (SIPD) company. We synthesize seven propositions for improved handling of business model change and add solution-oriented details to facilitate a cross-disciplinary discussion of broader implications on business-model research [134].

Digitalization, or digital transformation, is defined as "changes in ways of working, roles, and business offering caused by the adoption of digital technologies in an organization, or in the operation environment of the organization", and will drive significant changes to the process level, organization level, and business level of any company and their customers, as well as on the society level [125]. Digitalization drives new opportunities through digital transformation strategies [103] of the business environment [14, 103, 91]. Digitalization offers a significantly improved turnaround-time on a transaction, often by several orders of magnitude. As a consequence, the increased transaction speed drives new challenges for the alignment of business and technology changes.

SIPD companies are undergoing significant transformations and are struggling with the alignment of business and technology changes [155, 42, 91, 160] to find a lucrative mix between products, and services while remaining agile, effective and efficient [133, 107]. Until recently, SIPD companies handled increasing size and complexity by: 1) clearly distinguishing between the planning and realization layers for company strategy, product portfolios and individual products; and 2) handling change mainly in the realization layer and ensuring that the planning layer remains reasonably stable.

Driven by the digitalization, the speed of change in the planning layer increases substantially and, in many cases, reach the rate of change in the realization layer. As a result, negotiation, and risk management can no longer only rely on the sales and engineering departments, as the business models shift focus to the ecosystem and collaboration [108, 175, 138] and companies choose operating multi-business-models [155]. Business modeling literature also recognize the need for efficiently handling change as several authors discuss the dynamic nature of business models and change in the business environment, e.g., [57, 41, 142, 32, 72, 70, 138, 104, 52, 36, 9, 121] to name a few.

As software ecosystems are becoming increasingly important [49], new ways of mitigating the harmful effects of uncertainty and equivocality\(^1\) need to be

\(^{1}\)Equivocality refers to multiple and conflicting interpretations of a goal, situation, or task,
integrated with the existing business processes, to minimize misalignment when translating strategies into business execution, and lay the foundation for a learning organization [6].

This paper contributes to the business model discussion in three ways. The first contribution is a detailed solution-oriented, cross-disciplinary synthesis on the digitalization's impact on the alignment between business and technology change. We propose an extension to Ritter & Lettl's business model research framework [134] with Business Model Change (BMCh) based on the Value Membrane (VaM) and Learning Organization Design (LOD), to facilitate the analysis of business model dynamics and impacts on effectiveness and efficiency. As the second contribution, we forward seven propositions aimed at setting the context for a fusion between the practices of business modeling (BM) and requirement engineering as a new evolving practice Digital Business Modeling (DBM)\(^2\). Thirdly, we provide a list of consequences for industry and a cross-disciplinary research agenda derived from our synthesis.

The paper is structured as follows: In Section 2, we present our synthesis based on background and related work. With six propositions, we summarize vital concepts, such as business model and BM, value creation and value capture, VaM, LOD, BMCh, strategy and business plans, layered and tiered architectures, business flexibility (BF). In section 3 we present how the business environment changes for our industry case and our findings from the longitudinal study. In section 4, we summarize and discuss our results using the derived value membrane concept and develop one additional proposition. In section 5, we conclude our paper.

### 9.2 Background and Related work

The synthesis provided in this section is based on an extensive systematic literature review about efficiency, effectiveness [164] and flexibility of business modeling [162] published in our previous work. It is also derived from our design science study on how to capture changing business intents using context frames [153]. Our synthesis provides solution-oriented details to facilitate the development of a much requested, cross-disciplinary research agenda [134, 177, 161, 57] to name a few.

The focal point of this study is the misalignment between the planning (define) as compared to uncertainty which is derived from lack of information.

\(^2\)The term was first introduced by an SAP White paper, Digital Business Modeling: A Structural Approach Toward Digital Transformation, DOI: 10.13140/RG.2.2.22643.73766/1
and the realization (execute) of the SIPD business, in the fast-changing environment that a SIPD company operates. A change to either the strategy or the realization, has the potential to trigger an escalating misalignment. Formulating and executing a digital transformation strategy [103] has the goal to reduce such misalignment by managing the change. The term digital transformation strategy implies a business-centric context when coordinating strategies for products, services, and business models as a whole.

Building on Ritter & Littl’s business model research framework, we are inspired by their argumentation that the alignment perspective offers the significant contribution to the academic discourse and their analogy for the business model as a membrane between theories [134]. By analyzing uncertainty and equivocality [55] with (missing) value in a transaction, as the membrane between two actors in an activity system [177], we propose the business model can also act as the “contextual agent” in what we call the value membrane (VaM). The Value Membrane can help to identify the cause of the misalignment, and facilitate minimizing gaps between needed change, planned change, and implemented change.

Our literature review confirms that most scholars either focus on detecting or preparing change at one level (strategy, portfolio, or product), or analyzing the broader aspects of the organization, external environment, and innovation without separating the activities [164] and scholars are calling for further research on change realization, e.g., [121, 9, 119, 161]. Meier and Bosslau argue that there is almost no attention in research to the dynamic aspects, flexibility, validation, and implementation of business models [105], while Richter et al. emphasize the importance of understanding the degree of flexibility needed to realize change [133].

Seeing business models as activity systems helps organizations (as responsible for the business) adapt to change and generate value [57]. We agree with both Ritter & Littl and Curado on the importance of aligning the business model with organizational learning, to manage the strategies for developing the “Knowledge-worker” as the critical competitive resource for SIPD companies [134, 42].

We propose to extend Ritter & Littl’s framework with a business model research stream dedicated to Business Model Change (BMCh), as a practice derived from the core of Learning Organization design (LOD), see section 9.2.2. By connecting the BMCh practice via the VaM to the practice of LOD, we take a step towards a conceptual model for early risk mitigation and misalignment control. We also outline a governance control based on measurements, e.g., for effectiveness, efficiency, uncertainty, equivocality, and temporal effects.

The essential terms used in our synthesis and our conceptualization of the misalignment are; business model, value, transaction, learning organization, change,
and flexibility. Rooted in conversation theory [126], Promise Theory [12], and Knowledge creation theory [112], we examine each term from the two views, planning (define=top-down) and realization (execute=bottom-up), as proposed by Cavalcante in his investigation of the 'abstract' and the 'performative' levels of BMCh [32] and from our earlier work on business intents [153].

9.2.1 The impact of digital transformation on the nature of negotiating a business deal and equivocality

For many years, negotiating a business deal was a discussion focused on the functionality, price, and any potential project risks. The surrounding business environment (legislation, platforms and technology, partners and competition, etc.) posed little uncertainty related to the lifespan of the contract and the contractual obligations. Therefore, the negotiations could focus on the scope and usage of the underlying technical (software-based) solution. The business environment, including actors, business processes, and infrastructure was predominately "stable within reasonable risks" throughout the lifespan of the contract, and could be tracked by strategic planning, competitor and market analysis, monitoring standardization, and other regularly management initiatives.

For example, the negotiations in the GSM and 3G telecommunication standardization included a well-defined business environment and interfaces between the components. Suppliers could concentrate their risk management to monitor and participate in the standards development, while mainly focusing on optimal technology solutions for each component. Negotiating a new business deal, was fundamentally about understanding what components, the quantity, and any potential customer-specific features needed to sweeten the deal. This kind of contractual flexibility could be implemented by the product and solution engineers, under the strict coordination and risk management of sales, product management and top management.

Software Engineering has developed several concepts to support contractual flexibility, e.g., implementing Software Product Lines (SPL), iterative, lean, and agile software development with daily code deliveries enabling more advanced levels of customization. The ways of working were gradually built into, not only the product development process, but also into other core business processes like sales and delivery, and hence into the business model. Product Service Systems (PSS) [131, 130], Industrial PSS [105, 107], and service-based business models [82, 173] are examples of how this fusion of processes is continuously evolving.

With the digital transformation of the business environment [14, 103, 91], negotiation, and risk management can no longer rely on the sales and engineering
departments, but need to enact business model changes towards ecosystem and collaboration [108, 175, 138]. The negotiating power, coming from: (1) knowing what business flexibility (BF) can be offered; (2) how BF is translated into a contractual flexibility that can be absorbed by the business model realization (partners, organizations, and business processes); (3) without jeopardizing the underlying effectiveness and efficiency of products and technical solutions (promised contractual characteristics); emerges as a critical competitive advantage. However, with more roles participating in the negotiation [153, Figure 7 p.1182], uncertainty and equivocality can negatively impact quality, cost, and lead-time of both the planning and realization phases [55, 85, 34].

Companies undergoing the digitalization transformation should detect if the previously used realization strategy (the combination of the business model, products and services) still will adhere to the changed contractual terms and conditions. This involves checking if the current business model will accommodate the new terms and conditions, and the associated risks to deliver the changed contractual terms. The distance between strategizing, innovating, and planning for BMCh is significantly reduced. We argue that such risk management should be done before signing any contract, and therefore propose that,

**Proposition 1:** A mechanism for early-detection of business model change is a critical factor in maintaining a company’s negotiating power to ensure business success, via improved risk management derived from the business flexibility.

### 9.2.2 How business modeling scholars address change

**The Business Model**

Among the various definitions, interpretations, and usage of the business model concept (e.g., [121, 46, 51, 158, 8, 147, 72]), a consensus is growing for that value, organization, business logic, and activities are the core parameters of a business model [134, 177, 57]. Ritter & Lettl propose a framework centered around business model activities for merging the research perspectives of business models to remove ambiguity and move the field forward [134]. Zott & Amit argue the business model as an already robust, theoretically anchored construct for strategic analysis, and propose for cross-disciplinary research with seemingly similar concepts including organizational forms, ecosystems, activity systems and value chains [177]. Fjeldstad & Snow further highlight organization design and collaborative forms while arguing value configurations as the pivotal element
of the business model. They conclude, that only by making research findings more interpret-able and actionable managers could benefit from creating and maintaining business models [57].

We use Höfflinger’s business model definition as “the design of organizational structures for converting technological potentials into economically valuable outputs by exploiting business opportunities.” [72] since:

- He extensively integrates and builds on the literature for business models.
- He takes the top-down view on the business, addressing the issue of static versus dynamic business models and argues business model innovation as the approach to adapt to rapidly changing environments.
- He focuses on the consequences connected to multi-value, superior performance, and organizational learning, as the mechanism for feedback and control, thereby pushing for an integration of the business model with the cognitive aspects of the organization and governance.

The business model concept “is identified as the missing link between business strategy, processes, and Information Technology (IT)” [161]. Viet et al. highlight the importance of cognitive aspects in that the “questions regarding the impact of IT and its transformative power on individuals, society, business and organizations are therefore of central interest”. The business model also mediates the link between technology and a company’s performance, but the literature is missing the studies that focus on the interdependencies between business model choice, technology innovation, and success [7].

**Value creation and Value capture**

Value creation and Value capture are the central concepts associated with business models [57, 92]. According to Lepak et al., value creation is divided into ’use value’ (as perceived by an individual) and ’exchange value’ (as the monetary compensation) and should be related to the source and the target on different levels (individual, organization, and society). As such, value creation is highly subjective and context-specific but always created in interactions.

Value capture focuses on how value is shared, since an organization creating value, not necessarily may capture all value created, but instead share it with other stakeholders (value slippage). Understanding value capture is vital for understanding e.g., motivation, incentives, and how competition mechanisms can be maintained. On an organizational level, the business model literature discusses concepts such as value chain and value networks as ways to identify how to maximize and sustain value creation and capture [92].
Optimizing the total value creation requires profound understanding how the implemented business model (organization, policies, business processes, and systems) interacts with products and stakeholders for value creation and value capture [92, 115, 153, Figure 6 p.1181]. Therefore, ambiguities could easily be introduced into the business model [92] based on: (1) the plurality in the source, target, all with competing interests; (2) the mix of content and the process; (3) that value creation and value capture processes are mixed and overlapping; (4) and temporal effects, where human language and customer expectations simply evolve, e.g. the KANO model\(^3\).

Resolving such ambiguities demands transformation capabilities of values from one level to another level, e.g., a created value on an organizational level (the provider) is a complex aggregation of several unique values on the individual level, related to many different roles for the organization and its’ customers and partners. The organization’s knowledge-workers should facilitate such value transformation by continuously and efficiently turning needed capabilities into effective value-creating abilities via skills and knowledge [57].

Learning Organization design and the Value Membrane

Transforming capabilities into value-creation abilities through business model activities (BMa) is the fundamental goal of any organization [57]. Such transformation is based on individuals applying their skills and knowledge when using products and systems to deliver the intended value. Organizational learning is therefore critical for the capability/ability transformation [42].

The goal for organization design is to achieve effectiveness and efficiency in daily operations (BMa interactions between stakeholders) while continuously adapting to changing environments. An organization can be defined as “(1) social entities that (2) are goal-directed, (3) are designed as deliberately structured and coordinated activity systems, and (4) are linked to the external environment.” [43]. Item (3) and (4) match and overlap the BM definitions based on activity systems and organizational structures [175, 72]. Some concepts are vital for organization design: (1) Organizational configuration (e.g. Top management, Middle management, Technical core, Technical support, and Administrative support); (2) Organizational dimensions as critical design aspects for requirements on effectiveness and efficiency; (3) Organizational structure and grouping, derived from reporting relationships, staff grouping, and the design of systems for communication, coordination, and integration of efforts; (4) Linkage, as the extent of

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\(^3\)Developed in the 1980s by Professor Noriaki Kano, the Kano model is a theory for product development and customer satisfaction, see https://en.wikipedia.org/wiki/Kano-model
communication and coordination among organization elements; and (5) the Core transformation process (e.g., Sales and Marketing, Development, Service delivery, Customer relationship management).

Organization theory[43] states that an optimal organization design is the conscious result of merging Strategic design needs (environment, strategic direction) with the Operational design needs (work processes). The management responsibility lies in achieving and maintaining organizational effectiveness and efficiency, as a ’best fit’, by analyzing and setting the strategic direction. This implies a continuously change to the business intents while making tactical and strategic choices and business-aware compromises. As a consequence, the business intents are continuously changed and Figure 9.1 (based on [153, Figure 5 and 7]) illustrates the complexity behind these ’best fit’ decisions, as a recursive, complex web of interactions with overlapping lifecycles and relationships of organizational configurations and transformation processes. Making such choices have widespread implications for organization characteristics and forms the base for the organizational design (changed specifications of new and existing capabilities, together with updated goals and strategies). The organization continuously needs to transform strategies (via capabilities) into value-creating abilities, and tune for efficiency via operational feedback and control systems (governance, see left side of Figure 9.2). The overlap between the business modeling, organization design, and daily operations and the pressure to decrease the time of transactions, drives a new horizontal and integrated LOD [88].

In organization theory [43], organizational learning is associated with a horizontal organization design characterized by exploration, and is well-suited for turbulent environments. Opposite, the vertical organization seeks to exploit available resources within a focus on efficient performance in stable environments. More often, the goal of an organization is to become a more learning organization, but there is an inherent conflict between the principles of horizontal and vertical design. This conflict can be observed by looking at organizations as systems. The vertical organization is seen as a ’closed system’ (mechanistic) as the variability in its’ context (e.g., environment, culture) is tried to be shielded off and controlled. Typical vertical strategical choices are: (1) a high degree of formalization (rules) and specialization (roles); (2) tall hierarchy of authority; (3) centralization; and (4) products rather than services, as the organization tries to compete rather than collaborate. Horizontal designs are seen as ’open social systems’ or ecosystem (organic), with the guiding principle of communication and collaboration based on equality, little hierarchy, open information and culture, to enable and encourage problem-solving through participation and adaptability.

In reality, all organizations are hybrids [43]. With continuous (re)design of the organization, the primary challenge (and goal for LOD) is to find an optimal com-
Figure 9.1: The Value Membrane with the Designed Business Flexibility, as a capability/ability "shock absorber", derived from the interactions between stakeholders [153]

promise of vertical control for highest efficiency (exploitation), combined with a maximum BF and horizontal learning ability (exploration). Any organizational design can be evaluated and controlled through the organizational dimensions, of which the structural dimension captures aspects of Formalization, Specialization, Hierarchy of authority, Centralization, Professionalism, and Personnel ratios. The contextual dimension caters for Size, Organizational technology, Environment, Organization’s goals and strategy, and the Organization’s culture.

Despite the progress in management information systems (e.g. automation, visualization, and actionable reporting of goals with dashboards), there is still a struggle finding solid measurements that illustrates the conflict and necessary compromises needed between efficiency and a learning organization. The Linkage describe part of these relationships and the Vertical information linkage (to coordinate, top-to-bottom) are hierarchical (chain of command=reporting relationships), rules and plans, and vertical information systems. The Horizontal information linkage (to achieve unity in effort and organizational objectives) are cross-organizational information systems, direct contact, task forces, full-time integrator, and teams [43].

In this paper, we will specifically zoom in on the Organizational dimensions and
Linkage, when we connect the VaM to the practice of BMCh via governance, as a mechanism for the analysis of the Ritter & Lettl’s concept of BM Alignment [134], see the right side of Figure 9.2. We visualize the VaM as a 'best fit value-based surface', linking the learning organization to the effectiveness and efficiency of BMa, see Figure 9.1. We use the "shock absorber" analogy to visualize how the organization’s effectiveness and efficiency are dependent on that a correct level of Designed Business Flexibility (DF) is built into every Capability, in order for the Ability to be able to efficiently deliver the expected value in any performed BMa (i.e., by staff and systems in execution).

Also, Figure 9.1 illustrates four possible effectiveness and efficiency scenarios: (a) Effectiveness achieved within designed efficiency range = Optimal Fit; (b) Poor Fit, no effectiveness due to misunderstanding (uncertainty or equivocality); (c+d) Maximal Waste, no fit due to design flaw, bad compromise, or unforeseen dependencies between the abilities, resulting in zero efficiency for the invested flexibility. Scenarios b, c, and d will contribute to the loss of efficiency (time, cost) and effectiveness, affecting partner’s and customer’s value experience (loss of trust, quality, reputation, etc.) as well as internal values (motivation, commitment, creativity, innovation, etc.).

The information in the VaM could be structured in many different (contextual) views to simplify the evaluation of effectiveness and efficiency, e.g., according to organizational dimensions and linkage structures [43], value perspectives [80], changeability aspects [162, Figure 1], Business Model Motivation [116], the Business Model Canvas [118] etc. The value membrane can be seen as a container of the Linkage and the information found in the context frame. We suggest to use a compositional system of context frames to represent this information [153, Figure 8].

To address the dynamic behavior related to business models [164, 162], we propose to extend Ritter & Lettl’s framework with Business Model Change (BMCh), acting as the membrane between their five proposed research areas, see the right side of Figure 9.2. The practice of BMCh connects to the practice of LOD via the VaM (and a governance mechanism for the planning and realization levels).

By using an organization-centric view of the business model, focusing on BMa [57, 175], the transformation of capabilities into effective and efficient abilities can be illustrated as a recursive, bottom-up process (TCAP) in relation to the vital concepts for LOD (Effectiveness, Efficiency, Capability, Ability, Transaction, Knowledge, Domain knowledge, Feedback, Feed-forward, Exploitation, Exploration and Governance), see the left side of Figure 9.2.

The goal of LOD is to support the conversion of tacit knowledge into explicit knowledge, shared and efficiently made available on all abstraction levels [43,
Figure 9.2: The Value Membrane links the Learning Organization via the Effectiveness and Efficiency of Business Model Activities, to Business Model Change, as an extension to the Ritter & Lettl’s research framework [134].

To do so requires a sound understanding of the complex TCAP interrelationships, represented by all the arrows in the left side of Figure 9.2.

TCAP comprises three ‘cognitive’ processes (represented by the broad arrows in the figure): Value creation and Value capture (Vi+Ve), Knowledge Creation, and Knowledge Management (illustrated with examples of artifacts on different abstraction levels). Increased organizational learning and individual competence are often a result of a management focus and incentives for exploitation or exploration. The VaM links TCAP via governance to the organization (and the actors in any transaction related to BMa).

TCAP represents a complex inter-process relationship that operates in parallel, on different abstraction levels (e.g., individual, organization, and society) and is direction-sensitive. Examples are the Feed-forward loop of knowledge creation that goes from the individual to the collective (organization), while the Feedback loop goes in the other direction, supporting knowledge management [42]. Also, between the abstraction levels, there is a complex relationship between knowledge creation and knowledge management, where individual tacit knowledge is transformed into explicit knowledge (e.g., in transactions and meetings) and made available to the collective. Different theories are developed to explain these rela-
tionships, where Nonaka & Takeuchi’s SECI model uses the terms socialization, externalization, combination, and internalization [112] while Pask’s conversation theory uses the stages of explanation and exemplification until ‘strict understanding’ is reached, whereby new (explicit) knowledge is added to the current domain [126].

Temporal aspects are another source of unforeseen misalignment, and a challenge in handling these complex TCAP relationships, e.g., how does the temporal dimension interact with both memories of shared pasts, (mis)understanding of (new) facts, and learning [42]. Based on our work with intent-driven systems, [153], we propose that,

**Proposition 2:** A governance mechanism including VaM, needs to be based on a scalable information construct for describing (and sharing) the context for each role in a transaction. This can reduce both equivocality and uncertainty, and thereby minimizing potential misalignment.

We believe the critical factor, for governance enabled by VaM, is to achieve scalability, so the underlying information management system can gradually become automated, catering to informed decision support based on how value and knowledge affects effectiveness and efficiency in an interaction between two actors (machine or human). We argue that a key component to solve scalability is developing efficient information management systems for contexts, e.g. creating, sharing, searching, inferring, and updating information (policies and rules) related to existing explicit knowledge in collaboration between all roles involved [153, 152].

**Business Modeling Literature on the gap between Planning and Execution**

Business model experimentation is gaining more importance for SIPD companies, as a response to a growing need for business model innovation [36] and digitalization [91]. Experimentation is an approach to achieve effective change to the business, driven by the rationale that in “highly uncertain environments, strategies are about insight, rapid experimentation, and evolutionary learning as much as the traditional skills of planning and rock-ribbed execution” [104].

Central to the success of any business model is how the organization design is affected by the configuration of value and new collaborative organizational forms [57]. Fjeldstad & Snow recommend managers to close the gap in four key areas of their knowledge: 1) understand how value is created in your firm; 2) have a
plan for changing your business model; 3) know how collaboration fits into your business model; and 4) anticipate the future of your business model.

To analyze the gap between planning and execution whilst maintaining a focus on value creation and capture, we complement Höfflinger’s top-down definition of the business model with Rohrbeck et al. bottom-up definition of business modeling, “to be a creative and inventive activity that involves experimenting with content, structure, and governance of transactions that are designed to create and capture value” [137].

Inspired by Fjeldstad & Snow, we adopt the idea of value as the contingency variable affecting all other elements of the business model [57], and to understand the transaction- and role-dependent Direction of Value (DoV), we build on the value concept proposed in the Value Delivery Metamodel (VDML) [115]. We also adopt the terminology introduced by the Software Value Map (SVM) [80].

Maintaining a strong focus on value for customers, with the focus of improving the dialogue between business and IT development, Osterwalder proposes BM to include the following capabilities: (1) Understand and share, i.e., Capture, Visualize, Understand, Communicate and share; (2) Analyze, i.e., Measure, Observe, Compare; (3) Manage, i.e., Design, Plan, Change & Implement, React, Align, and Improve decision-making; and (4) Prospect, looking into the future, i.e., Innovate, Business model portfolio, Simulate and test [117]. These four groups of capabilities, together with the four knowledge areas proposed by Fjeldstad & Snow provide us the boundaries of the practice of BM.

However, neither Höfflinger [72], Fjeldstad & Snow [57], nor VDML [115] makes a clear separation between value creation and value capture. Also, neither Osterwalder [117, 120] nor Zott et al [175] make an unequivocal distinction on what level value is discussed in the value creation and value capture processes. We, therefore, propose that

**Proposition 3:** Value translation and value transformation capabilities are essential for BM. By exploring value, in an interaction on the individual level as the unit of analysis, we can resolve ambiguities in relation to the different areas of the business model (e.g., product offering, product delivery, product development, finance, customer relationships, partner management) stemming from: (1) the **direction of value**; (2) inter-level relationships of source and target for value; and (3) aggregation issues for value creation and value capture.

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4See http://www.softwarevaluemap.org for the SVM tool and latest details, as it is continuously updated by input from more than 50 companies world-wide, November-2018.
and value slippage).

Business Model change

Both radical or incremental business model changes need [87] to be addressed both at the planning and the realization levels [32]. However, given the elusive nature of the boundaries and the dynamic behavior of business models, Cavalcante et al. defines the business model boundary as “the core repeated standard processes of a company’s business model” [33]. Cavalcante summarized the two streams of literature dealing with BMCh: (1) the more traditional approaches advocate the need for a careful analysis before effective change can occur; and (2) the recent approaches through experimentation and trial-and-error. He divided BMCh into four types of change: business model creation; extension; revision; and termination. He further argued there is a ‘pre-stage’ of ‘potential of BMCh’ before the actual change occurs, often including analysis, experimentation, and other activities to build insights, learning, and commitment. Therefore, he proposes to develop a detailed guide for analyzing BMCh, both at the level of cognition as well as action, where he sees continuous experimentation and learning as fundamental pillars for effective BMCh, transforming the company into a ‘permanent learning laboratory’.

To address change on the planning level, a company needs to understand the As-Is situation, (which capabilities exist), and the effects on the To-Be situation (needed abilities) due to an identified misalignment. Such insights require understanding how strategy relates to business model, tactics, and residual choices [29], in combination with what strategic agility [52] and level of strategic flexibility [148] the organization has.

To facilitate such insights, we propose to represent a business model, by combining the work by Ghezzi’s on value networks (VN) and resource management (RM) [63], with Osterwalder’s business model canvas (BMC) [118]. Therefore, a company’s need for BMCh can be derived from having profound knowledge and a sound understanding of the three dimensions: (1) the customer(s) and related relationships; (2) the value proposition (revenue streams, what values to create, how to deliver it to the customer); and (3) the company’s assets (products, resources, activities, cost structures, and partner relationships).

If there is any change of knowledge in one or more of these dimensions, a potential BMCh could be triggered [47, 63]. Consequently, a change in any of these knowledge dimensions will trigger a recursive “change-reaction”, as an interactive transformation of the original ideas, ambitions (business intents [153]), and experiences into organizational learning [6]. The change-reaction eventually results
in a new “steady-state” for the company’s knowledge.

To address change on the realization level, i.e., solutions implemented in products, processes, and organizations, literature discuss concepts like business model operationalization (BMO), implying reconfiguration and tuning of the company’s assets [9], aligning business with IT [119, 144, 143], business model experimentation [36, 104], collaborative business modeling [138], Dynamic Software Product lines [27], R&D as innovation experiment systems [73], just to name a few. With the advent of the digital business strategy [14], we propose that,

**Proposition 4:** SIPD companies possess a unique advantage for detecting and implementing BMCh. By using their software development process to integrate their business model innovation with their product innovation, they can efficiently develop ‘native’ product support for managing the linkage of contractual flexibility to the configuration of software products, to achieve richer levels of business model experimentation and collaborative business modeling.

Examples of such ‘native’ product support could be developing specific functionality dedicated to supporting the core business processes or the integration of the product into the ecosystem. Examples of ‘native’ software features could be visualizing available choices and simulating consequences on cost, lead-time, and value, implementing feedback and feed-forward loops for tuning effectiveness and efficiency, measuring and detecting equivocality in collaborations, measuring customer satisfaction), to name a few.

### 9.2.3 Business Flexibility

Flexibility is “is the ability to adapt when confronted with new circumstances...and provides the organization with the ability to change to adapt to change and respond quickly to market forces and uncertainty in the environment.” [97]. Richter et al. points out that embedding flexibility into system design can address risks in relationships and optimize stakeholder’s incentives, turning incomplete contracts into opportunities [133]. They discuss changeability as a term to better understand investments in flexibility related to value, cost, and risk. Changeability is defined by options under internal (‘robustness’ and ‘adaptability’) respectively external control (‘flexibility’ and ‘agility’).

In the business and management literature, flexibility is discussed in many different contexts, as related to business models and as ways to managed change, e.g., strategic flexibility [101, 148], resource and organizational flexibility versus
dynamic capabilities \cite{10, 146, 159, 62}, and business model flexibility\cite{101, 100}. Manufacturing literature suggests that building flexibility entails identifying uncertainty, implementing the appropriate decisions, and monitoring the achieved flexibility \cite{21, 61}.

Variability management is a discipline focused on implementing flexibility in software products \cite{26} and optimizing the flexibility depending on the values to achieve, often in combination with other initiatives, e.g., Dynamic Software Product lines \cite{27}, Product-Service Systems \cite{105}.

We define Business Flexibility (BF), as the "negotiable options in: 1) Relationship; 2) Financial; and 3) the Value proposition between two parties trying to reach an agreement". These options are needed for an effective negotiation to leverage a company’s ability to compromise without breaking the promise in the final contractual agreement. The terms Relationship, Financial, and Value proposition refer to the context of Osterwalder’s right side of the BMC \cite{118}. Using the BMC, a company visualizes the strategic decisions and critical business options that characterizes the rationale of the business idea, and how it strategy-wise will be turned into a successful business (model) realization. The main difference between a strategic decision, and deciding on a business option, is fundamentally, 'when in time' the option is 'frozen' and considered too expensive (or risky) to change. In a SIPD context, timing examples could be, at design-time, deployment-time, or run-time, while on a business model level, negotiating with a new supplier is a business option, while deciding on a partner and platform is more likely a strategic decision.

A change (on planning or realization level) is triggered by a gap (misalignment) in expectations and what is delivered. Such gaps exist inside organizations, in their business processes, as well as in their products and services. Closing these gaps (transforming a capability into an efficient ability) requires significant investments in time and effort, involving a multitude of collaborating roles (internal and external).

Also, closing the gap adds an extra dimension to the notion of flexibility, as for how to realize a solution \cite{27, 133}. It requires new knowledge on how to create, invest in, and continuously manage an efficient linkage between the organization’s strategic and dynamic flexibility to the software products variability and the contractual flexibility. Therefore, to maximize the BF will affect almost every aspect of the company, e.g., organization, management and financial systems, product development, outsourcing, sales, human resources, skills and knowledge management. As such, investing in mechanisms for efficient BMCh requires a cross-disciplinary approach, putting the organization in focus, in the same way as the digitalization does \cite{91}. We therefore propose that,
Proposition 5: SIPD companies have a unique opportunity for implementing business flexibility and efficiently creating value propositions. SIPD companies should develop software architectures and software functionality to enable a synchronized change in their business model and products using BM.

9.2.4 Strategy, Product Portfolio, and Product levels (3-layer model)

Early work on business models was not so distinct between the different concepts of business plan, business model, strategy, and tactics. Casadesus-Masanell & Ricart argued a clear distinction between strategy and the business model, where the business model “is a reflection of the firm’s realized strategy” and that the strategy is the plan and process to reach the desired goal via the business model and onto tactics [29]. Strategy refers to the choice of the business model while Tactics refer to the residual choices open to the company.

The Business Motivation Model (BMM) “provides a scheme or structure for developing, communicating, and managing business plans in an organized manner” [116]. The BMM separates the business plan into three layers, ENDS, MEANS, and Realization. It also helps us understand how to structure the critical elements of a business plan, and how these elements relate to a business model. Using BMM plus a business model, a company could model their total operations, from company vision, via several business models, business processes, and down to individual tasks and rules guiding each decision and choice. Such schemas are in use and also heavily researched, e.g.; TOGAF\(^5\), MEMO [58], Capability-Driven Development [13], Next-Generation Enterprise Information Systems [123], but they still struggle to keep up with complexity, scalability, speed, accuracy, and cost in a networked economy [139].

Loose coupling, i.e., separating the top layer descriptions from the bottom layer with a middle layer, provides separation of concerns and increases the maintainability of each layer by limiting impacts due to changes in the other layers. Such pattern can be found in many different contexts, e.g. Ends, Goals, Means chains [67]; Presentation layer, Business layer, Data layer in Software architectures\(^6\); Business Item Library, Capability Library, Practice Library [115]; Commoditized

\(^5\)The Enterprise Architecture standard used by the world’s leading organizations to improve business efficiency, http://www.opengroup.org/subjectareas/enterprise/togaf

functionality layer, Differentiating functionality layer, Innovative and experimental functionality layer \[18\]; Business architecture, IS architecture, and Technology architecture\(^7\).

However, when combining such patterns into a conceptual model, contextual ambiguity becomes a challenge since each layer may discuss a ‘topical’ view, rather than a strictly defined Tier that can be distinctly separated. Contextual ambiguity can result in layers overlapping, creating new (often hidden and unknown) dependencies, resulting in unforeseen consequences and gaps in the contextual model.

To minimize contextual ambiguity and allowing a ‘contextually floating’ abstraction level suitable for the value contingency variable, we build on BMM, TOGAF, MEMO, and VDML to define our 3-layer BMCh Abstraction model (BMCh AM) as ‘Business layer’, ‘Capability layer’, and ‘Realization layer’. We use TOGAF’s definition of Capability “as an ability that an organization, person, or system possesses. Capabilities are typically expressed in general and high-level terms and typically require a combination of organization, people, processes, and technology to achieve. For example, marketing, customer contact, or outbound telemarketing.”.

Please note, that by using BMCh AM, we consequently only use a Capability to describe an Ability. A Capability should not include any realization, allowing for options how to perform the ability optimally, e.g., outsourced, as tasks in activities and processes, automated business processes, by machines, humans or mixed. The Amazon Mechanical Turk\(^8\) is an excellent example of such a Capability/Ability transformation. Initially a technically overwhelming problem to automate tasks considered only possible to be performed by human intelligence, solved by innovative software, grew into an entirely new type of business solutions (and business models). The example also illustrates the crucial importance of clearly distinguishing between the plan (linking to a description of the capability) and the realization (the ability to offer, perform, and deliver the capability under different contextual conditions, as stipulated in a contract). BMCh AM enables business innovation while balancing quality, speed, and flexibility. The Mechanical Turk replaced by AI technology does not change the Capability, only the realization of the Ability.

We, therefore, by combining BMM, TOGAF, and VDML, with ‘context frames’ \[153\], propose that

\(^7\)Three layers of architecture to support the requirement management in accordance with the architecture vision. The Open Group Architecture Framework (TOGAF), http://www.opengroup.org/subjectareas/enterprise/togaf

\(^8\)See https://www.mturk.com/
Proposition 6: Given our 3-layer BMCh AM ‘Business layer’, ‘Capability layer’, and ‘Realization layer’, we can conceptualize BMCh as ‘a gap between BF, efficiency, and value’.

9.3 An industry case, adapting to the digital transformation in the telecommunication industry

For Ericsson AB\(^9\), one critical aspect of achieving the business and technology transformation and managing change, has been a long-term focus on industrialization and automation of the product development and the delivery (via process innovation). For example, its AXE family of telecommunication switches, created in the 1970’s, is recognized in the Software Product Line (SPL) Hall of fame\(^10\). Ericsson has shown remarkable adaptability and flexibility during the past 50 years of technology growth and software (engineering) evolution. Two critical strategies laid the foundation for this success. By (1) actively driving the telecommunication standards, the business environment could be kept reasonably stable, enabling (2) an efficient industrialization built on the core processes of developing, testing, and delivering software-intensive products and solutions.

However, the digitalization and servitization transformations require additional strategies for handling the fast-paced business environment than driving technology standards. The technology innovation must be in concert with an equally dramatic and accelerating business model innovation. Ericsson’s business model has evolved from the resource-centric, standard product-sales model, via several product and service models, over into different use models, where software-intensive products and services now are sold and delivered as-a-service and on demand. Today, Ericsson are running multi-business-model operations, and with that, facing additional challenges to keep up with the pace of change. A majority of these challenges can be structured according to Ritter & Lettl’s framework, see the right side of Figure 9.2, aiding the understanding of risks related to effectiveness, efficiency, and misalignment due to temporal effects related to uncertainty and equivocality.

\(^9\)https://www.ericsson.com/en
\(^10\)SPLC, the premier conference for SPL with an A2 listing, http://splc.net/hall-of-fame/
9.3.1 Business model change

Digitalization and servitization shifted the business risks to new dimensions, e.g. business ecosystem (sharing and collaborating in fierce competition), rather than optimizing the own company’s assets as a part of a value-delivery chain (e.g., traditionally mitigating risks with long-term business agreements and international standards). Such BMCh, profoundly impacts the financial steering and control, as much of the investments need to be taken up-front, while the majority of revenues shifts to on-demand usage rather than sales of products [105, 133]. More importantly, the transition from business models based on selling products or hourly-rated services (with a strong focus on add-on sales), into value-based, knowledge-intensive, customer-unique use-models, has affected many of Ericsson’s dynamic and strategic capabilities and most of the core business processes. To remain efficient, a higher level of flexibility and re-use between the different business models artifacts were needed.

For Ericsson, this also impacted the organizational design, requiring extended focus on organizational learning and incentives, governance and management structures suited for the inherent dynamics, as well as collaborating with strategic and operational information with tools under secure forms. It also required enhanced clarity in responsibility and authority for the business model activities, in order to optimize the value the organization were supposed to create.

As our industrial case highlights, the industrialization and automation strategy was heavily challenged when the boundaries between value delivery and R&D were quickly blurred, as the time between the development, signing of contracts, and support and feedback from organizations and customers, decreased rapidly and the process became more asynchronous (realized through agile development and servitization, with on-demand customer adaptations migrated into standard components).

In hindsights, and analyzed using Ritter & Lettl’s framework, see right side of Figure 9.2, it was clear that the Ericsson traditional, engineering-centered industrialization approach, would have benefited by categorizing the strategic program’s requirements and associated risks into the five areas, highlighting that the program was actually facing a BMCh. By addressing the extent of the misalignment between the effectiveness (‘do the right thing’ as a top-down strategic planning process) and the efficiency (as the bottom-up change of existing BMa, business processes, organizations, and tools), we believe the scale of the program, as well as the temporal affects, due to uncertainty, equivocality, overlapping goals, and changing organizational responsibilities, could have been predicted and managed in a better way by proposing a set of different tactics (stemming from a BMCh), thereby invoking a higher degree of top management commitment and atten-
A majority of the issues in our investigated program showed to be connected to the effectiveness area, and in particular related to misjudging the temporal affects, when reaching a common understanding (minimizing equivocality) of the goals and tactics to accommodate the new goals with existing organizational goals. Given the global, widespread scope of the program, and the frequent changes to involved organizations, establishing a reporting structure for how the different tactics supported each other (and executed by the different parts of the organization), turned out to be slow and inefficient, causing mistrust and unnecessary tensions. We believe this program would have benefited from a BMCh-centered approach, rather than a engineering-focused servitization approach, by achieving over-arching clarity and consensus between top-management, middle management, and the affected organizations, highlighting it was not just 'business as usual'.

9.3.2 The longitudinal study (2012-2016), a global program for industrializing services

Back in 2012, the Ericssons’ service organization, established in 2007-2008, was mainly working in two types of business models:

- Managed Services - running the operator’s network for them with large, long-term contracts.
- Service consultancy and Delivery model - focused on project deliveries and learning services.

As part of a corporate strategy realization to put the customer first, the service organization devised their strategic program "Global Scale - Local Reach", involving 75000+ resources (global, regional, and contractors) in nine regions, working in three segments of the service portfolio (Managed Services, Product Related Services, and Consulting and System Integration). The goal of the program was to improve customer responsiveness, improve productivity, and improve internal benchmarking.

We conducted a longitudinal case study between 2012-2016, where we actively worked alongside teams responsible for

- supporting the program manager and his steering group with a business and enterprise architecture analysis,
- responsible for the business level requirements towards tools and IT development, and
• consultants for the deployment (business processes and training) into the sales and delivery organization (global plus nine regions).

In the beginning of the program (2012-2013), we participated in eleven extensive workshops interviewing practitioners from affected areas: finance; product management (services and software products); key account managers; Ericsson IT (master data, business processes, and system responsibles); sales; delivery (project); and support processes (planning, development, and pricing, of services). The 3-4 hours workshops were based on a short introduction to the workshop and the program, followed by practitioners presenting their current business processes and ways of working. Practitioners were then interviewed on current issues and potential opportunities was discussed under the frame of the new program, providing us with great insights of the scope plus the strategical and the operational issues facing the program. The workshops also provided a deeper understanding of the level of uncertainty, equivocality, and rivalry between the different roles and organizations. We were also given continuous access to all program-related information, monthly reports, and steering group protocols.

To identify any misalignment against the program’s (original) goals and the actual outcome in the deployment and to understand the longitudinal effects of the program (2012 and 2016), we also conducted two sets of individual, 60+ minutes interviews, with a delivery project manager and a solution architect.

As a pilot, Ericsson applied the industrializing of the sales and delivery processes in 30+ deliveries to customers in three regions during 2013. These pilot projects delivered contract scoping efficiency and accuracy improvement by 88% - first time right. The ordering process was considered simplified, while delivery lead time, and project costs were reduced by 12-35%. However, the program complexity and program duration were significantly underestimated (duration exceeded by 150%). We identified three main reasons for the increased complexity:

• the scalability of the piloted solution turned out a bigger issue than anticipated.
• the inherent complexity (flexibility and re-usability) of the services to be industrialized and the services’ dependency on the skills and knowledge of the service delivery staff.
• frequent re-organizations - this could be traced back to a substantial BMCh together with an insufficient support for fast and cross-organizational learning, negatively impacting the transformation program.
The integration of new IT tools with the updating of the business processes

The program struggled with two major challenges. First, to decide what services to industrialize and which should remain 'customer-specific' (due to required customer variability vs. investing in standard product options vs. a too high dependency on the skills and knowledge of the service delivery staff). Secondly, to find the best balance and road-map for the new and updated IT tools in order to minimize disruptions to operations while concurrently updating the business processes.

The technical solution to the first challenge was basically divided in five parts, with a need for completely new tools to be integrated with existing tools and processes. The second challenge proved to be complex mainly due to the volume of tacit and explicit information in various forms of knowledge representations, and realizations with efficient knowledge management systems.

Related to the second challenge, the decisions between investing in tool support versus investing in business process flexibility (requiring more skilled staff and investments in more options in the products) turned out to be very challenging, mainly due to the multi-disciplinary value argumentation presentation to the decision makers and top management. The consequences of such investment decisions were even more challenging to agree upon cross organizations, and made necessary prioritizations and re-allocation of resources difficult and time-consuming (traversing organizational hierarchy R&D, sales, delivery, and Ericsson IT).

As a consequence, the 'traditional' IT update and integration process of new and existing tools to match the evolving business processes, was affected by misunderstandings and delays leading to temporary solutions in the sales and delivery organization. Under customer pressure to deliver on signed contracts, this led to decreased trust between organizations, affecting the efficiency of the collaboration.

It also proved difficult to synchronize the business process development (sales and delivery processes to use industrialized services) with the agile Ericsson product development (the new generation of products to be delivered using the updated business processes). We identified the following four root causes of the misalignment:

• temporal effects due to different life cycles of these two core business processes,
• organizational steering, coordination and incentives,
expected capabilities that did not deliver on the requested abilities in customer projects, and

• the differences between the old and new product generations, the needed training of the service delivery staff, and their valuable customer experience feedback to the R&D organization.

Temporal effects of organizational learning

The temporal effects of organizational learning created a gap between feed-forward and feedback loops, see the left side of Figure 9.2. The different organizations (R&D, sales, delivery, Ericsson IT) were occupied with their life-cycles of change as committed in earlier plans, see Figure 9.1 (specifically [153, Figure 5]). The symptoms of this were observed in areas of communication, coordination, training, and reporting, resulting in uncertainty, equivocality, and sub-optimization at best and a lack of abilities at worst.

Scaling the solution was affected since planned capabilities needed by different organizations were not translated (in time) into required abilities, i.e., integrated tools and staff adequately trained in relation to the new or changed business processes (so they could perform the tasks demanded by the evolving business model). The scale of the industrialization problem was among the most significant factors since it affected the amount of information and the relationships between the affected organizations involved in the change processes. The rippling change-reaction escalated and started to violate existing goals, commitment, and reporting, leading to more efforts spent on temporary, local solutions to assure customer contracts could be honored.

9.4 Results Summary and Synthesis

This study confirms opportunities and challenges for the servitization and the digitalization reported by scholars, for example, [107, 37, 133, 155]. Our interviews revealed that in practice, the scalability, the complexity of roles and (changing) business intents, and the size of the solution were perceived as the most significant challenges.

The case study also highlights the added complexity of BMCh for large SIPD companies that operate with contracts spawning years to complete. This calls for a combination of BMCh and organizational design. What appears to be inevitable is that the business environment will change during the execution of the
underlying agreements. These changes might not be possible to be absorbed by
the variability in underlying software-based realizations (and business processes),
and will ultimately lead to dropped business, unsatisfied customers, partners, and
contractual penalties hurting the company even more.

This calls for a deeper understanding of the required business flexibility to se-
cure the negotiation of contracts and value creation into efficient realizations,
delivering and capturing the agreed values, all at an acceptable level of risk and
cost level. In short, the business environment, which used to be stable for years,
is soon changing with every contract, forcing the underlying realization to be
validated and adjusted at every contract negotiation.

The longitudinal case study uncovered that it was possible to improve customer
responsiveness. We speculate this is an effect of the industrialization forcing
clarity and better descriptions to products, services, and the business processes
(the exploitation phase of knowledge management was improved). Improving
productivity was also possible in the pilot, but towards the end of the program
(2016) voices were raised that the investments made into the program would
not sustain an increased productivity, mainly due to many re-organizations and
changing the incentives for the learning organization.

We speculate this to be a symptom of Ericsson running a multi-business-model
operation in combination with an on-going BMCh. Our interview respondents
believed that governance mechanisms should facilitate continuous review and
update of strategies and goals, to support the different organizations executing
different business models. The governance mechanism should also cope with
efficient facilitation and the speed of the exploration phase (Knowledge Creation
process), transforming tacit knowledge into explicit knowledge fast enough and
made available through the Knowledge Management process, see the black arrows
in the left side of Figure 9.2.

The single, most time-consuming activity was to arrive at a shared understanding
of the problems since all roles must participate to provide their expertise. Related
to Pask’s states of explaining and exemplification in combination with Nonanka’s
SECI, we estimated that early phases of the program consumed up to 80% of the
time, and the overall program was estimated to 30-40% of time being spent on
some form of organizational learning.

During the program’s first year, we found that using value (i.e. SVM) as a com-
mon denominator in any discussion, and structuring the discussions topic-wise
around one BMC area at the time, was an efficient tactic to decrease uncertainty
and equivocality.

The program showed that productivity could go up by industrializing the ser-
vices. But not having a telecommunication standard to lean on, revealed that the flexibility needed for each service, in combination with sizing each service were intricate engineering, competence, and sales problems. To achieve higher productivity and profitability, all parts of the organization needed to continuously experiment and tune the combination of software product’s components and the service product’s size, while also developing skills for sales negotiations and the service delivery.

We believe it requires fast, efficient Feed-forward and Feedback loops between R&D, sales, and the service delivery organizations, see the rounded arrows in the left side of Figure 9.2, illustrating the continuous interaction between Knowledge Creation and Knowledge Management processes. Support for these loops should preferably be implemented both in the products as well as in the business processes. We therefore propose that,

**Proposition 7:** The practice of Digital Business Modeling (DBM) should be coined as a fusion between current practices of business modeling and requirement engineering, and become a key practice in LOD to facilitate business model innovation through experimentation.

### 9.5 Conclusion

The global economy is increasingly digital, networked, and knowledge-based, which requires a company to constantly reconsider their chosen business models and to modify them to adapt to changing conditions. To keep pace with the dynamic global economy, a company must be agile in their management of both the operational and dynamic dimensions of their business models.

Many distinguished scholars have highlighted the cross-disciplinary complexity stemming from the on-going digitalization and transformation of the business environment [161, 139, 91, 177] to name a few. This complexity is derived from critical multi-perspective cognitive factors like value, human abilities, collaboration, experimentation, learning, trust, politics, human behavior, etc. It is also intrinsically related to engineering principles and aspects like quality, effectiveness, efficiency, cost, speed, as well as efficient solutions for information management systems, addressing the inherent conflict between humans and machines on simplicity vs. correctness, with issues like scalability, usability, semantics, domain-specific modeling and languages, to name a few.

We highlight three critical aspects of business modeling in the analysis of the
misalignment between planning and execution. Firstly, focus on experimenting [137], as a ‘round-trip’ process of ‘translating an idea into execution, test, evaluate, and change until satisfied’ (similar to the agile method of developing software products followed up by proper retrospectives). Secondly, focus on transactions [175], thereby connecting the business model to human behavior and value in execution and planning activities. Thirdly, the analysis is direction-sensitive, with minimum two (role-dependent) views of the transaction, implying an information representation suitable for maintaining (observe, analyze, decide, change) many relationships (supporting efficient collaborations through all the stages of the business model lifecycle, e.g., plan, design, deployment, execution, phase out) [153].

We propose Business Model Change (BMCh) as an extension to Ritter & Lettl’s business model research framework and its’ business model alignment [134]. We believe that addressing BMCh by linking it to Learning Organization Design via the Value Membrane could address many of the identified cross-disciplinary challenges, as indicated by Legner et al. “digital transformation requires a focus on the business solution first... the foundations for the technological system background should be laid, rather than vice versa“ [91].

This paper is an initial step for such a detailed, cross-disciplinary guide for handling BMCh. Synthesizing from two literature reviews [164, 162], a design science study [153], and the case study presented in this paper, we present seven propositions for addressing the challenges of aligning the planning and execution layers for software-intensive product development (SIPD). We also highlight four critical aspects that SIPD companies need to address, to develop their competitive advantages, maintaining operational effectiveness and efficiency, while moving further into the information age:

- Business model innovation for the business ecosystem, e.g., driven by markets and contextual changes, co-creation of value, collaboration within and between organizations, partners, communities, and customers, new streams of revenue while sharing of risks, revenues, and costs [138, 137].

- A digital SIPD, focused on automation and integration of business and software architecture, information, and tools. Products designed for mass-customization in a collaborative agile development, can sustain the speed of change and increasing demand of customer experiences (delivered as cloud services) [114, 26, 119, 98].

- Badly designed organizations, ill-suited for experimentation and collaboration in a digital business world, affecting both the product development as well as the value delivery, e.g., agreement structures, incentives, processes, knowledge management and organizational learning, measurements
of effectiveness and efficiency, revenues, cost, decision-making based on multifaceted optimization and transparency [88, 77].

- The level of integration and automation between the four processes of value creation, value capture, knowledge creation, and knowledge management [92, 42]. This is the foundation for an innovative enterprise and should be nurtured as a key competitive advantage.

Acknowledgement

This work has been supported by the Professional Licentiate of Engineering (PLEng) Pilot Run 2014-2018 from The Knowledge Foundation in Sweden in cooperation with Ericsson AB. This work is also supported by the ORION project (reference number 20140218) from The Knowledge Foundation in Sweden.
Appendix A

Appendix for PAPER 1 and PAPER 2
A.1 Selected articles

Table A.1.1 lists all the articles selected through the snowballing methodology. It contains Paper ID, author/bibliographic reference, plus extracted data for rigor and relevance factors (EP3), paper content (EP4), and the number of topics (RQ1+RQ2+IC2+IC3)\(^1\) addressed by the paper. A detailed description of EP3 (including calculation of scores) and EP4 are found in the Appendix A.3 while details of IC1-IC3 are found in Appendix A.2.

In the main article we use the notation \([\text{Paper ID}, \ldots]\) to indicate a reference to one or more of the study’s selected papers when we specifically talk about a result or an synthesis thereof. Please note that the start set consists of P1-P10.

\[
\begin{array}{|c|c|c|c|c|c|c|c|c|c|c|}
\hline
\text{Paper ID} & \text{Authors/Ref} & \text{Year} & \text{Rigor (EP3)} & \text{Relevance (EP3)} & \text{Content (EP4)} & \text{No. of RQ+IC} \\
\hline
P1 & Woodard et al. [167] & 2013 & 1 & 1 & 1 & 1 & 1 & 1 & 2 & 4 \\
P2 & Rohrbeck et al. [137] & 2013 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P3 & Reim et al. [131] & 2013 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P4 & Hackney et al. [71] & 2004 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\
P5 & Chew [37] & 2014 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\
P6 & Ballon [9] & 2007 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P7 & Loss & Crave [96] & 2011 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\
P8 & Romero & Molina [138] & 2011 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P9 & Höllinger [72] & 2014 & 0.5 & 1 & 0 & 0 & 0 & 0 & 0 & 3 \\
P10 & Goel et al. [66] & 2009 & 0.5 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P12 & Casadesus-Masanell & Ricart [29] & 2010 & 0 & 0 & 1 & 0 & 1 & 0 & 3 \\
P13 & Chesbrough [36] & 2010 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P14 & Demil & Lecocq [48] & 2010 & 1 & 0 & 0.5 & 0 & 0 & 1 & 0 & 2 \\
P15 & Doz & Kosonen [52] & 2010 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\
P16 & Dubossoson-Torbay et al. [53] & 2002 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\
P17 & Hacklin & Wallnöfer [70] & 2012 & 1 & 0.5 & 0 & 1 & 0 & 1 & 1 & 1 & 3 \\
P18 & McGrath [104] & 2010 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 3 \\
P19 & Richardson [132] & 2008 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 & 3 \\
P20 & Storbacka & Nenonen [157] & 2011 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 2 \\
P21 & Zott & Amit [175] & 2010 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\
P22 & Baden-Fuller & Morgan [8] & 2010 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2 \\
P23 & Gao et al. [60] & 2011 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 \\
P24 & Kindström [82] & 2010 & 1 & 1 & 0.5 & 1 & 1 & 1 & 1 & 2 & 4 \\
P25 & Meier & Massberg [106] & 2004 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 & 2 \\
\hline
\end{array}
\]

\(^1\)IC1-IC3 are topic-oriented while IC4 and IC5 are related to rigor and relevance

132
### Table A.1.1: Selected papers including extracted properties.

<table>
<thead>
<tr>
<th>Paper ID</th>
<th>Authors/Ref</th>
<th>Year</th>
<th>Rigor (EP3)</th>
<th>Relevance (EP3)</th>
<th>Content (EP4)</th>
<th>No. of RQ+IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>P26</td>
<td>Meier et al. [105]</td>
<td>2010</td>
<td>0 0 0</td>
<td>1 0 1 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>P27</td>
<td>Richter et al. [133]</td>
<td>2010</td>
<td>0 0 0</td>
<td>0 0 0 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P28</td>
<td>Schuh et al. [149]</td>
<td>2009</td>
<td>0 0 0</td>
<td>0 0 0 0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>P29</td>
<td>Zott et al. [174]</td>
<td>2011</td>
<td>0.5 1 1</td>
<td>0 0 0 0</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>P30</td>
<td>Amit &amp; Zott [3]</td>
<td>2001</td>
<td>1 1 1</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P31</td>
<td>Baden-Fuller &amp; Haeßfliger [7]</td>
<td>2013</td>
<td>0.5 0 0</td>
<td>0 0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>P32</td>
<td>Osterwalder et al. [121]</td>
<td>2005</td>
<td>0 0 0</td>
<td>0 0 0 0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>P33</td>
<td>Al-Debei [45]</td>
<td>2010</td>
<td>0.5 0 0</td>
<td>1 1 1 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>P34</td>
<td>Bouwman [19]</td>
<td>2006</td>
<td>0 0 0</td>
<td>0 0 1 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>P35</td>
<td>Buder &amp; Felden [25]</td>
<td>2012</td>
<td>1 1 1</td>
<td>0 1 0 0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>P36</td>
<td>Cortimiglia et al. [40]</td>
<td>2015</td>
<td>1 1 1</td>
<td>1 1 1 1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>P37</td>
<td>Ghezzi [63]</td>
<td>2013</td>
<td>0.5 0.5 0.5</td>
<td>1 1 1 1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>P38</td>
<td>Ghezzi [62]</td>
<td>2012</td>
<td>0.5 0 0</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P39</td>
<td>Haafer et al. [68]</td>
<td>2004</td>
<td>0.5 0 1</td>
<td>1 1 1 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P40</td>
<td>Kruemich et al. [86]</td>
<td>2012</td>
<td>0 0.5 0.5</td>
<td>0 0 0 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>P41</td>
<td>Zolnowski &amp; Böhmann [173]</td>
<td>2011</td>
<td>0.5 0.5 0</td>
<td>0 0 0 0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>P42</td>
<td>Andries &amp; Debackere [4]</td>
<td>2007</td>
<td>1 1 0.5</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P43</td>
<td>Björkdahl [15]</td>
<td>2009</td>
<td>0.5 0.5 0.5</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P44</td>
<td>Casadesus-Masanell &amp; Llanes [28]</td>
<td>2011</td>
<td>1 0 0</td>
<td>0 0 0 0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P45</td>
<td>Doganova &amp; Eyquem-Renault [51]</td>
<td>2009</td>
<td>0.5 0.5 0</td>
<td>1 1 1 1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>P46</td>
<td>Mason &amp; Leek [100]</td>
<td>2008</td>
<td>0.5 0.5 0</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P48</td>
<td>Lindström [95]</td>
<td>2014</td>
<td>0.5 0.5 1</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P49</td>
<td>Eirich et al. [56]</td>
<td>2014</td>
<td>0.5 0.5 0</td>
<td>1 1 1 1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>P50</td>
<td>Ning et al. [110]</td>
<td>2011</td>
<td>0.5 0.5 0</td>
<td>1 1 0 0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>P51</td>
<td>Dmitriev et al. [50]</td>
<td>2014</td>
<td>1 1 1</td>
<td>1 1 1 1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>P52</td>
<td>Schneider &amp; Spieth [148]</td>
<td>2014</td>
<td>0.5 0.5 0.5</td>
<td>1 0 0 1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>P53</td>
<td>Short et al. [151]</td>
<td>2013</td>
<td>0 0 0</td>
<td>1 1 0 1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>P54</td>
<td>Meier &amp; Boßlau [105]</td>
<td>2013</td>
<td>0.5 0 0</td>
<td>1 1 1 1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>P55</td>
<td>Giessmann et al. [64]</td>
<td>2013</td>
<td>0.5 0.5 0</td>
<td>1 0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>P56</td>
<td>Salgado et al. [144]</td>
<td>2014</td>
<td>0.5 0 0</td>
<td>1 1 1 1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>P57</td>
<td>Kim et al. [81]</td>
<td>2008</td>
<td>1 0 0</td>
<td>0 0 0 0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P58</td>
<td>Mason &amp; Mouzas [101]</td>
<td>2012</td>
<td>1 1 1</td>
<td>1 1 1 1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>P59</td>
<td>Salgado et al. [143]</td>
<td>2014</td>
<td>0 0 0</td>
<td>0 0 0 1</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
A.2 Inclusion and exclusion criteria

To identify literature related to our research questions, we developed the Inclusion criteria (IC) and Exclusion criteria (EC) listed in Table A.2.1. These criteria allow us to explore why BM is used, how it is applied, and what solutions currently exist. Since our research topic covers multiple research disciplines, we decided to address the RQs by designing the IC as wide as possible, to give us a large variety of articles discussing BM (IC1) in any relationship to effectiveness and efficiency. To evaluate BM efficiency, it is important to connect the business strategy via the business model to the execution of the business model with a traceability to daily operations and results. So to understand if business modeling enables effectiveness and efficiency, we want to know how a business model can be operationalized by developing the right type of flexibility (variability in the realization, IC3) matching all desired strategical and tactical choices (business flexibility, IC2).

Business modeling allows an organization to identify and prioritize changes to current business operations (content, activities, and governance). This change is continuously translated into a realization of the business model, through experimentation or otherwise, by understanding how the desired flexibility can be operationalized using modularity in design and software-based systems to support content, activities (all stakeholders, e.g., internal organization, partners, suppliers, and customers) and governance.

Effectiveness and efficiency should be evaluated from the gap between all strategic and tactical choices, in combination with how the organization (and supporting software) utilize the remaining flexibility to create satisfied customers in everyday transactions. The dilemma of not only implementing the right flexibility (supporting the needed business options) but also implementing it efficiently, is key to success, i.e., the right level of variability in the realization combined with the appropriate changeability in the realization to facilitate experimentation with the operationalized business model.

The selection criteria was based on IC1 AND (IC2 OR IC3 OR IC4 OR IC5) to achieve a broad selection of papers as possible. If only the term Business model were used (and not specifically Business modeling), the paper could still be a candidate if it referred to activities related to creating, maintaining, or otherwise using a business model.
### Table A.2.1: Inclusion and Exclusion criteria.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Evaluate (=Yes)</th>
<th>Reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC1</td>
<td>Exclude if Not written in English</td>
<td>Must be able to read and understand to evaluate</td>
</tr>
<tr>
<td>EC2</td>
<td>Exclude if Not peer-reviewed</td>
<td>Basic Quality assurance of paper</td>
</tr>
<tr>
<td>EC3</td>
<td>Exclude if duplicated</td>
<td>Snowballing will give many duplicates</td>
</tr>
<tr>
<td>IC1</td>
<td>Does the abstract, introduction, conclusions (or full text if needed) mention purposes, benefits or challenges (PBC) for business modeling?</td>
<td>Papers must identify real problems and issues related to business model, business modeling or business model innovation.</td>
</tr>
<tr>
<td>IC2</td>
<td>Does the text mention aspects of business flexibility (BF)?</td>
<td>BM is becoming increasingly complex due to growing business ecosystems and the digitalization of the value delivery, which both introduce a need for variability in the offering. Offering services on top of products are one example to address BF.</td>
</tr>
<tr>
<td>IC3</td>
<td>Does the text mention aspects of variability in the realization (VR)?</td>
<td>Planning a business model is not enough. It needs to be efficiently realized as well, so the business flexibility needs to be matched with a variability in the realization of the business model. Offering Software Product lines (SPL) or Product Service Systems (PSS) are examples of addressing VR.</td>
</tr>
<tr>
<td>IC4</td>
<td>Is it an empirical study?</td>
<td>We want to investigate how business models are used in practice, and not only in theory. Empirical is done in an industrial context, no student work, no proof of concept, no examples even if they are “based on real data”</td>
</tr>
<tr>
<td>IC5</td>
<td>Is it referring to a SIPD context?</td>
<td>The realization of business models is highly dependent on software due to the digitalization of the value delivery. This opens up new opportunities for value capture (and value creation) in the business ecosystems.</td>
</tr>
</tbody>
</table>
A.3 Data Extraction properties

Table A.3.1 lists the data extraction properties used for this study and maps their relevance to each RQ. Properties EP1-EP4 are evaluated per paper and used to analyze the relevance to industry for each paper’s contribution. Properties EP5-EP9 use open coding and the extracted data was thematically and narratively analyzed.

Property EP1 and EP2 are subset of property EP3 (Rigor & Relevance) where property EP2 categories the paper’s context. We extend the definition of Context (EP3 [75]), by adding (large-scale) Software intensive industry. The relevance parameter (EP3), we coded with binary weights (originally proposed as plain sum of 0 or 1), allowing us to visualize the impact of different relevance aspects. The weights were guided by RQ1, hence setting our priority: Industry (8), Scale (4), Subjects (2) and Research method (1), e.g. a value of 9 or higher would represent anything in “industry” with at least one additional relevance aspect met. Originally the Relevance element of property EP3 focus on the paper’s context in relation to industry so we added property EP4 (Paper content) to map the relevance of each paper’s content related to answering the RQs.

EP5 corresponds to our inclusion criteria (IC). EP6 was used to look for patterns on the business model construct as to describe what it is, why it is important and how it is used. This is important since the topic of BM is wide and lacks a clear definition. EP7-EP9 was used to understand the context for effectiveness and efficiency as related to business modeling.
Table A.3.1: Data Extraction properties.

<table>
<thead>
<tr>
<th>Id</th>
<th>Evaluate</th>
<th>How</th>
<th>RQ mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>EP1</td>
<td>Research Methods</td>
<td>Action research, Case study, Conceptual analysis, Design</td>
<td>Relevance of paper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Science research, Experiment, Interview, Literature review, Not</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>stated, Other SW intensive, Industry, General (e.g. Literature</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>review), Non-industry (in priority order)</td>
<td></td>
</tr>
<tr>
<td>EP2</td>
<td>Paper Context</td>
<td>Detailed rubric definitions per aspect [75]</td>
<td>RQ1 and relevance</td>
</tr>
<tr>
<td>EP3</td>
<td>Rigor &amp; Relevance of the paper</td>
<td>Rigor: Context is described</td>
<td>Overview and relevance</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rigor: Study Design is described</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rigor: Validity is discussed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Each Rigor aspect measurement: Strong description (1), Medium</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>description (0.5), and weak description (0)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relevance: Context (weight=8), i.e. in industrial setting</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relevance: Scale (weight=4), i.e. realistic size and industrial</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>scale</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relevance: Subjects (weight=2), i.e. industry professionals</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Relevance: Research Method (weight=1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Each Relevance aspect measurement: Contribute to relevance (1), Do</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>not contribute to relevance (0)</td>
<td></td>
</tr>
<tr>
<td>EP4</td>
<td>The relevance of the paper content in respect</td>
<td>Coded 1-3: (1) Business modeling. The paper discuss specifically the</td>
<td>RQ1</td>
</tr>
<tr>
<td></td>
<td>to Business modeling.</td>
<td>process of modeling your business</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2) Business model. The paper mainly focus on the Business model</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>and discuss how different aspects of the Business model constructs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>are developed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3) Other. It only refers to a specific business model(s), or</td>
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<td></td>
<td></td>
<td>discuss specific instances thereof, or a topic related to business</td>
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<tr>
<td></td>
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<td>model (e.g. flexibility). Therefore of minimal significance to our</td>
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<tr>
<td></td>
<td></td>
<td>study.</td>
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<tr>
<td>EP5</td>
<td>IC1-IC3</td>
<td>Use ATLAS TI to extract related quotes for each RQ.</td>
<td>RQ1, RQ2</td>
</tr>
<tr>
<td>EP6</td>
<td>Business Element context</td>
<td>Use ATLAS TI to extract related quotes referring to a part of the</td>
<td>RQ1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>business model construct, what it is, why it is important and how it is used and relates to other parts</td>
<td>RQ2</td>
</tr>
<tr>
<td>EP7</td>
<td>Practice/Technique Measurement perspective</td>
<td>Use ATLAS TI to extract quotes referring to a practice or technique</td>
<td>RQ1, RQ2</td>
</tr>
<tr>
<td></td>
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<td>presented, described or used.</td>
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</tr>
<tr>
<td>EP8</td>
<td>Success indicator and metric</td>
<td>Use ATLAS TI to extract quotes related to</td>
<td>RQ2</td>
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<td>- Product view (how well is the value created)</td>
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<td>- Process view (how efficient have you organized the value flow)</td>
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<td></td>
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<td>- Resource view (how well is the resource utilized and adapted for</td>
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<td>the needed task)</td>
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<td>- Project view (how efficient is the goal fulfilment)</td>
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<td>- Relationship view (how effective is the communication)</td>
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<tr>
<td></td>
<td></td>
<td>Use ATLAS TI to extract related quotes.</td>
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A.4 Quotes of purpose, benefit and challenges

Table A.4.1 lists the quotes of purposes, benefits, and challenges for business models and business modeling, extracted from the selected studies (see Appendix A for paper references). All quotes have been categorized into common areas (first column), and then listed under respective primary context they are found in. We use prefix notation (+) for benefit, (-) for challenge, and [Pid] for the paper reference.
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<tr>
<th>Common areas</th>
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<tr>
<td>Mind-set, Knowledge</td>
<td>Experimenting [P2], [P22], [P49]</td>
<td>Enhance creativity, unlock barriers of innovation [P2]</td>
<td>Mediating, facilitating and sharing strategic discourse [P17], [P36]</td>
</tr>
<tr>
<td></td>
<td>Shift company’s boundaries [29]</td>
<td>Build trust [P2]</td>
<td>Address lack of knowledge [P45], [P22]</td>
</tr>
<tr>
<td></td>
<td>Exploit business opportunity [P22], [P29]</td>
<td>Increase readiness via portfolios and simulation [P9], [P32]</td>
<td>(+) unlocks barriers of innovation + building trust [P2]</td>
</tr>
<tr>
<td></td>
<td>Foster Innovation [P32]</td>
<td>Build knowledge [P22]</td>
<td>(+) breaks cognitive structures and act as communicative, mediating device for shared meaning and commitments [P17], [P32]</td>
</tr>
<tr>
<td></td>
<td>Increase knowledge [P29]</td>
<td>(+) uses of mixed techniques between Business and IT improved communication and IT development [P56]</td>
<td>(+) improves understanding, language and legitimacy [P17], [P32]</td>
</tr>
<tr>
<td></td>
<td>(+) focus beyond company-centric focus [P17]</td>
<td>(-) how to achieve organizational and customer learnings incorporated into iterative design [P5]</td>
<td>(+) formalization forces implicit understanding becoming explicit (move strategy into execution) [P17]</td>
</tr>
<tr>
<td></td>
<td>(+) shifts focus from WHAT resources to HOW to use them [P18]</td>
<td>(-) lack of formality and analyst dependency with high skills [P56]</td>
<td>(-) lack of formality and analyst dependency with high skills [P56]</td>
</tr>
<tr>
<td></td>
<td>(+) BMI enables strategic renewal [P36]</td>
<td>(+) promotes outside in view on customer value [P18]</td>
<td>(+) promotes outside in view on customer value [P18]</td>
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<tr>
<td></td>
<td>(-) turns shared meaning into identity lock-ins [P17]</td>
<td>(+) provides early warning for threatened BM via analysing dynamism of competitive advantage [P18]</td>
<td>(+) provides early warning for threatened BM via analysing dynamism of competitive advantage [P18]</td>
</tr>
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<td></td>
<td>(-) resistance to change [P17]</td>
<td>(+) highlights consistency strategy and BM building blocks [P24]</td>
<td>(+) highlights consistency strategy and BM building blocks [P24]</td>
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<tr>
<td></td>
<td>(-) plan for “experimentation and learning” in established companies [P18]</td>
<td>(+) provides new insights (externalize, map and store knowledge) [P32]</td>
<td>(+) provides new insights (externalize, map and store knowledge) [P32]</td>
</tr>
<tr>
<td></td>
<td>(-) systematic servitization (product to service shift) [P24]</td>
<td>(+) fosters systematic BMI [P32]</td>
<td>(+) fosters systematic BMI [P32]</td>
</tr>
<tr>
<td></td>
<td>(-) hard to define business requirements (lack of information and specific details) [P56]</td>
<td>(+) unambiguously defines dimensions, properties and semantics [P33]</td>
<td>(+) unambiguously defines dimensions, properties and semantics [P33]</td>
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<td></td>
<td></td>
<td>(+) visualization improves understanding [P32], [P56]</td>
<td>(+) visualization improves understanding [P32], [P56]</td>
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<td>(+) helps define goals [P32]</td>
<td>(+) helps define goals [P32]</td>
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<td></td>
<td>(+) educates decision-makers for informed decisions, goals and requirement engineering</td>
<td>(+) educates decision-makers for informed decisions, goals and requirement engineering</td>
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<tr>
<td></td>
<td>Adopt servitization to further enhance global competitiveness [P54]</td>
<td>Commercialize ideas &amp; technology [P29]</td>
<td>(+) improves design of sustainable business models [P32]</td>
</tr>
<tr>
<td></td>
<td>(+) Prepares implementation (identifying joint activities with priority and validating the business model) [P2]</td>
<td>(+) better requirement engineering [P32]</td>
<td>(+) improves alignment of strategy, organization and technology and integration business IS/IT domains [P32]</td>
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<tr>
<td></td>
<td>(+) Helps to build better strategies (e-business) [P32]</td>
<td>(+) facilitates and improves choices in IS/IT [P32]</td>
<td>(+) BM may enable strategy execution and how operational choices affect company’s performance [P37]</td>
</tr>
<tr>
<td></td>
<td>(-) Business model design requires better integration with strategy analysis [P37]</td>
<td>(-) difficult to mobilize and align available resources (not only internal but also extending external base) in time [P9], [P15], [P24]</td>
<td>(+) helps to react to environment change due to strategic flexibility and dynamic capabilities [P52]</td>
</tr>
<tr>
<td></td>
<td>(-) Difficult to be systematic (too slow, too detailed, iterative) [P17]</td>
<td>(-) integration, agility and change [P10]</td>
<td>(-) hard to reach and maintain alignment of business model and information system model [P59]</td>
</tr>
<tr>
<td></td>
<td>(-) limited empirical validation [P17]</td>
<td>(-) barriers to change business model are real processes and tools are not good enough [P13]</td>
<td>(-) value co-creation is a hard cooperative process (speed, coordination, compromise) [P8]</td>
</tr>
<tr>
<td></td>
<td>(-) provides good insights but lacks support where to start investing to reach future business [P18]</td>
<td>(-) a structured service development process connected to the business model [P24]</td>
<td>(-) how to industrialize large-scale service offerings [P24]</td>
</tr>
<tr>
<td></td>
<td>(-) capture customer’s reaction to new technology [P5]</td>
<td>(+) how to avoid isolated change (relationships, value, dynamic portfolio) [P24]</td>
<td>(+) how to visualize, document and share basic elements due to relationships and speed of change [P26], [P32]</td>
</tr>
<tr>
<td></td>
<td>(-) hard to effectively balancing (conflicting) requirements (user and design) and strategic interests (of partners) [P39]</td>
<td>(-) hard to visualize, document and share basic elements due to relationships and speed of change [P26], [P32]</td>
<td>(-) hard to achieve consistency between BM and BPM and achieve real improvements with BPM [P35]</td>
</tr>
<tr>
<td></td>
<td>(-) tools conceptual, complicated and too time consuming (for network centric BM) [P53]</td>
<td>(-) lack of appropriate methods and tooling for BM integrated with BPM [P35]</td>
<td>(-) lack of appropriate methods and tooling for BM integrated with BPM [P35]</td>
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<td></td>
<td>(-) paradigm shift business activities and consumption patterns must be aligned with environmental and social objectives [P53]</td>
<td>(-) BM design requires better integration with strategy analysis models [P37]</td>
<td>(-) BM design requires better integration with strategy analysis models [P37]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-) discovery of goals and rules no common process for elicitation [P56]</td>
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<tr>
<td>Ends</td>
<td>Describe position of company in value network [P7], [P13], [P29]</td>
<td>Operationalize strategy [P36], [P37]</td>
<td>Alignment of strategy, business organization and technology [P32]</td>
</tr>
<tr>
<td></td>
<td>Formulate competitive strategy with goals and objectives [P19] [P37]</td>
<td></td>
<td>Act as a scale model and role model for characterization of similarities and definition of difference [P22]. (+) facilitates and improves choices in IS role and structure [P32]</td>
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<tr>
<td></td>
<td>Act as receipt for the business [P22]</td>
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Table A.4.1: Quotes on purpose, benefits and challenges for BM.
Bibliography


isbn: 9781622768271.


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ABSTRACT

Digitalization initiates and drives significant changes to the process level, organization level, and business level of software-intensive product development (SIPD) companies and their customers. Digitalization creates new opportunities through digital transformation strategies of the business environment. Digitalization also significantly reduces the turnaround-time on a transaction, driving new challenges for the alignment of business and technology changes. For a successful business model realization, a company must understand what capabilities the organization has (in staff and products), what is required, and more importantly, how to turn these capabilities into good-enough abilities without disturbing the effectiveness and efficiency of the daily operations. Integrating the product and service development and the value delivery with a learning organization is critical for efficient business model change (BMCh).

This thesis seeks to develop conceptual models for how BMCh is linked to value, learning organization design, and the transformation of capabilities into abilities derived from business model activities and actor interactions. Such conceptual models facilitate to investigate and identify critical mechanisms and capabilities needed to effectively and efficiently manage BMCh at full scale for SIPD companies, allowing them to exploit the on-going digitalization, may it be through (disruptive) business model innovation, technology innovation, or by continuously adapting and evolving the business operations.

I use the SIPD company as the unit of analysis, with the dual-lens of value and knowledge, set in the context of a business model and how the value creation and capture are influenced by the interaction between two actors performing a business model activity. I build on the business model literature and infuse theories for knowledge creation, learning organizations, and contractual promises to create value. Conducting a cross-disciplinary literature review, followed by a synthesis of related literature, industry best-practices, and an associated design science study, my propositions were validated in a longitudinal case study exploring a service industrialization program in the telecommunication industry.

I have produced five conceptual models and seven propositions as a start to be able to support the design of a governance mechanism, as the critical engine for both the learning organization and effective and efficient BMCh. The industry now explores the models found during the case study.

My synthesis shows a need for further research into BMCh regarding early detection and measurements of gaps in value, gaps in knowledge, ambiguity, equivocality, and abilities. Flexible role-based governance views present the measurements, as part of the governance mechanisms for full-scale, effective, and efficient BMCh. Further, I also aim to implement such governance mechanisms in software, by using the associated research in intent-driven systems. In the meantime, I propose industry to build knowledge and experience related to the seven propositions.