GI-Edition

Lecture Notes in Informatics

Andreas Helferich, Dimitri Petrik, Gero Strobel, Katharina Peine (Eds.)

1st International Conference on Software Product Management 2023

Software Product Management in the Era of Data Driven Products, Services and Ecosystems

Organized by „GI Fachgruppe Software Produktmanagement im Fachbereich Wirtschaftsinformatik (WI PrdM)“, Frankfurt, 2023

Andreas Helferich, Dimitri Petrik, Gero Strobel, Katharina Peine (Eds.):
1st International Conference on Software Product Management 2023

334

Proceedings

GESELLSCHAFT
FÜR INFORMATIK

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1st International Conference on Software Product Management

03.05.2023
Frankfurt am Main, Germany

Gesellschaft für Informatik e.V. (GI)

Lecture Notes in Informatics (LNI) - Proceedings
Series of the Gesellschaft für Informatik (GI)

Volume P-334

ISBN 978-3-88579-728-9
ISSN 1617-5468

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Preface

The International Conference on Software Product Management bridges the gap between research and practice to address software product management in the age of data-driven products, services, and ecosystems. For the first time, the international conference is hosted by the Software Product Management (WI-PrdM) expert group within the Management of Application Development and Maintenance (WI-MAW) expert committee of the Gesellschaft für Informatik (German Informatics Society).

The ICSPM is cooperating closely with ISPMA e.V. and its parallel Software Product Management Summit Europe. The venue for both events is the Hotel NH Collection Frankfurt City in Frankfurt am Main. The International Software Product Management Association (ISPMA) is an open, non-profit association of experts, companies, and research institutes to promote cross-industry excellence in software product management.

These conference proceedings contain the accepted research papers of the ICSPM. Nevertheless, the ICSPM sees itself as practice-oriented and, for this reason, in particular, encourages practitioners to submit significant empirical reports. Thus, we see technology transfer as a characterizing feature of our conference, in addition to welcoming scientifically innovative contributions.

Out of a total of 12 submitted contributions, six were accepted in a peer review process. This corresponds to an acceptance rate of 50%. Thematically fitting to the conference, two keynote speakers were invited: Prof. Dr. Jan Bosch (Chalmers University of Technology) and Patrizia Sickinger (Mercedes-Benz Group AG).

Jan Bosch is a professor at Chalmers University Technology in Gothenburg, Sweden, and director of the Software Center (www.software-center.se), a strategic partner-funded collaboration focusing on the topic of digitalization between 17 major European companies (including Ericsson, Volvo Cars, Volvo Trucks, Saab Defense, Scania, Siemens, and Bosch) and five universities. Previously, he served as Vice President of Engineering Process at Intuit Inc, where he also led Intuit's open innovation efforts and led the central mobile technology team. He holds an MSc degree from the University of Twente (Netherlands) and a PhD from Lund University (Sweden). His keynote addresses the shift in product management during the transition from "what to build" to "what results to achieve", the challenges encountered in this framework, the benefits, as well as the new techniques available. He discusses these points using numerous examples from the industry based on research conducted at the Software Center.

Patrizia Sickinger is a team leader in the IT department for the implementation of product portfolio management, marketing, and quality management for enterprise-wide backend infrastructure products as well as services within the "Dynamic Platforms & CDO" organization. Patrizia has been employed at Mercedes-Benz AG since her studies in Business Administration from 1980 -1983 as one of the first students at the University of

Cooperative Education. During this time she has held various positions in Human Resources, Research & Development, Finance & Controlling, and IT. Currently, she and her team are involved in building the data ecosystem for Mercedes-Benz. In her keynote, she will share her experience of implementing comprehensive portfolio management for classic IT products, services, and solutions, keeping track of not only operations but also marketing for these products, as well as improving the quality of related processes.

The six accepted contributions cover a wide variance of different aspects of software product management. The contribution of Moroz et. al. describes the topic area of product operations (short: product ops) in the context of the analysis of grey literature, thus the publications from practice. The contribution by Katharina Wagner, Felix Schönhofen, and Georg Herzwurm deals with the development and evaluation of a competence model for product management in software-intensive industries and business models.

In their paper, Helena H. Olsson and Jan Bosch address the challenges companies face when introducing new, data-driven business models or services, shifting existing revenue models to "as a service" models, and rethinking long-established practices in the area of data usage. Yevgen Bogodistov, Antonia Schwaiger, and Daniel Beimborn used a discrete choice experiment to analyze the differences in the expectations of top management, middle management, and the operational level concerning digitization initiatives and derived key success factors for successful implementation.

Based on 16 expert interviews with product owners, Timo Toikkanen et al. examines the question of what similarities and differences exist between the role of the product owner in the agile Scrum approach and the role of the software product manager. In the last article, Marcus Pietzker and his coauthors present a framework for developing business models for product platforms for enterprise software.

We would like to thank all participants, especially the authors and the speakers for enriching the program, the members of the program committee and the reviewers for the reviews, the keynote speakers for the exciting contributions, and the sponsors as well as the last but not least our cooperation partners at ISPMA e.V.! Without the commitment of all involved this conference would not have been possible!

We are looking forward to an interesting conference and hope for many exciting discussions and great new ideas!

Frankfurt, May 2023

Andreas Helferich, Dimitri Petrik, Gero Strobel, Katharina Peine

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Contents

Software Product Management: from opinions to data-driven experimentation (Academic Keynote)

Prof. Dr. Jan Bosch[1]

Abstract: With the digitalization of industry and society, product management of digital technologies such as software, data and AI is rapidly becoming critically important. Digitalization offers new tools for product managers to increase the return on investment of R&D including DevOps, DataOps and MLOps. These fast feedback loops allow product managers to adopt a much more experiment- and data-driven approach, e.g. using A/B testing and other experimental approaches. Product management is at the transition point from "what to build" to "what outcomes to accomplish". The keynote addresses this transformation, the challenges that one has to address while transitioning, the benefits as well as the new techniques available. The talk will share numerous examples from industry based on our research in the context of Software Center (www.software-center.se), a collaboration between 15 international companies and 5 Swedish universities focused on accelerating the digital transformation of the European software intensive industry.

Keywords: Software Product Management, experiments, data-driven

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Theory vs. Practice of Product Portfolio Management – views from real life of a major corporation (Industry Keynote)

Patrizia Sickinger[1]

Abstract: Have you ever discussed the topic of necessarity having a comprehensive portfolio Management for classical IT products, -services and –solutions? Or still more: Implementing that task? This is the mission that Patrizia and her staff have been working on since end of 2021 – during Corona, big organizational changes and new working models like agile, scrum or right now SAFe. And not only are they working on conceptual tasks, but also implementation and future operation, additionally Marketing for the products and starting to build up more quality in their processes. This presentation shows why and how they want to do this, where there are still issues and how they try to change this: tackling the challenges to change an old traditional automotive company into a very modern innovative data-driven automotive software enterprise.

Keywords: Product Portfolio Management, Major Corporations, Agile Management

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Helferich et al. (Hrsg.): 1st International Conference on Software Product Management,
15 Lecture Notes in Informatics (LNI), Gesellschaft für Informatik, Bonn 2023

Product Ops: Understanding and Defining an Emerging Discipline

Bogdan Moroz[1], Andrey Saltan,[2] and Sami Hyrynsalmi[3]

Abstract: Product Operations (Product Ops) is a concept gaining momentum among product management practitioners in the software domain. Practitioners share success stories and describe various benefits of implementing Product Ops in software organizations. However, there is a lack of consensus on a definition and areas of responsibility of the role, which may lead to inconsistencies and flaws in its implementation. An abundance of practitioner publications on the subject with varying descriptions of the discipline calls for standardization and the development of a systematic approach to discussing Product Ops. Moreover, only a handful of academic publications have briefly touched upon this concept. In response to this research gap, the paper reports the results of a grey literature review and proposes a definition of the Product Ops concept emerging in the software product management practitioner literature. The tasks and responsibilities of the function are described, alongside the expected positive outcomes of implementing the Product Ops. The risks of flawed implementations are also acknowledged. Furthermore, the paper outlines potential avenues for future research in this domain.

Keywords: Software Product Management, Product Ops, Software Business Definition, Grey Literature Review

1 Introduction

Product Operations (Product Ops) is a relatively new company function intended to enhance product management with an explicitly separated operational component, to create a more efficient approach to developing and delivering software-intensive products. Many of the responsibilities now attributed to Product Ops have historically fallen on the shoulders of product managers. The reorganization and redistribution of duties between Software Product Management (SPM) and Product Ops is meant to enable product managers to concentrate on the core SPM areas related to product strategy and product planning, while attracting experts with operational and analytical skills to assume some of the operational responsibilities. Product managers are commonly referred to as "mini-CEOs" [Ki22, Eb07], and this comparison can be extended to Product Ops, which could be referred to as "mini-COOs" [Pe19a], where COO stands for Chief Operating Officer, a high-level executive position responsible for the operations of a company.

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The introduction of Product Ops eliminates certain functions and responsibilities of software product managers and allows them to focus on the overall strategic direction of product development [Me20, It22]. Product Ops practitioners optimize the product development lifecycle by identifying and removing bottlenecks and inefficiencies. Product Ops and SPM work together to ensure successful product development [Es21]. While SPM sets the strategy and tactics, Product Ops provides the methods, tools, and processes to achieve these goals and ensure the product fully meets customers' expectations and needs.

The current rise of Product Ops aligns with the trend of expanding operations in software and digital businesses, and introducing such novel business functions as Sales Ops (sales operations), RevOps (revenue operations), DevOps (development operations), DevSecOps (development, security, and operations) and Marketing Ops (marketing operations) [Bu17, Ca23, Fe22]. Organizations have been driven to introduce these roles and functions to bridge the gap between business units and create cohesive and well-coordinated teams. Such cross-functional teams should improve the efficiency, effectiveness, and agility of company initiatives, as well as keep up with the changing market conditions, new technologies, and the increasing complexity of modern business operations.

Practitioner publications on the subject of Product Ops offer a variety of definitions, rife with metaphors and analogies to other disciplines and domains [Ja22, Pe19a, Sa18, Na22, LS23]. Several publications explicitly state that the role is "different at every company" [Pe19a, Ja22, Ca21]. One expert, for example, shares encountering six vastly different company functions all titled "Product Ops" [Ca21]. The lack of clarity around a specific definition and responsibilities calls for a more systematic look at Product Ops since "*the dust appears to still be settling*" [Pe19a]. Given the abundance of practitioner publications on the subject with varying degrees of specificity, it is worth establishing a coherent definition for the discipline. Wide usage of a term in varying contexts may lead to it loosing its original meaning, and, eventually, all its meaning, becoming what Ulrich Beck describes as a "zombie category" [HH19]. Despite the different organizational contexts and perspectives, there are elements of Product Ops that are consistently mentioned across publications. These include the areas of responsibility of Product Ops professionals - supporting product managers in the areas of data management [Pe19b, Ja22, Pe19a, Pe19c, Pe18], experimentation [Pe19b, Ja22, Pr22a, Pe19a], tooling and processes [Pr22b, Ja22, Pr22a, Ca21, Pe19a, Pe19c, Na22, Dr22]. Commonalities can also be observed in the descriptions of the positive impact of the role, including increased organizational efficiency and improved ability to scale [Ja22, Pe19a, Ha20, Pe18, Dr22].

As of now, Product Ops has not been adequately studied in academic literature. We could not identify any research paper, in January 2023, that directly addressed the concept of Product Ops. The lack of scientific publications necessitates employing a grey literature review and focusing on identifying, analyzing, and integrating non-peer-reviewed sources [GFM19, SS21]. Reviewing grey literature promises to provide valuable insights and knowledge about the phenomenon by revealing practitioners' perspectives, voices, and

viewpoints [ASH17, La14]. Once conducted, our study offered insights into the current state-of-the-practice of Product Ops in software-developing organizations and contributed to a more comprehensive and nuanced understanding of this concept.

The rest of this paper is structured as follows. Section 2 defines the research questions of this review and introduces the methodology used in the process. Section 3 shows the results of the review and presents our definition of Product Ops. It is followed by a discussion with proposals for further work avenues in Section 4 and concluding remarks in Section 5.

2 Methodology

Facing the lack of prior research on Product Ops, this study aims to address the following research questions:

RQ1 What are the definitions and schools of thought on the concept of Product Ops?

RQ2 What are the responsibilities of Product Ops?

RQ3 What outcomes or impacts can be expected when implementing Product Ops?

The identified research questions and the lack of prior academic studies on Product Ops suggest employing a grey literature review. Grey literature includes a wide range of sources, such as industry reports, white papers, and knowledge shared by practitioners through podcasts, interviews, and blogging. Traditional literature reviews often overlook grey literature and focus on peer-reviewed journal articles. However, grey literature can provide valuable insights and perspectives not represented in peer-reviewed literature and can therefore be an essential source of information for understanding the phenomena being studied [GFM19]. By answering these questions with a grey literature review, this study aims to clarify the definition and responsibilities of the Product Ops company function, and the potential benefits of implementing one.

The search of grey literature publication began by searching for the term “Product Ops” on Google. Sources were added to a spreadsheet, where they were numbered and classified by publication type and source type. The researchers then read the sources in their entirety and wrote condensed summaries of their contents to the same spreadsheet. New sources referenced from the reviewed sources were followed and added to the spreadsheet as well, in a “snowballing” approach. The condensed summaries of the identified sources were reviewed again, and the key ideas from the condensed summaries were placed into a mind map diagram. Similar themes, concepts, and arguments were grouped together in the mind map, with clear references to their sources.

Several sources were explicitly rejected, primarily based on their relevance and originality. One of the rejected sources was determined to duplicate the contents of another source, whereas another was in the Finnish language (the only one of the identified sources).

Additionally, several sources were left out from the body of literature for the review due to the scope of the study. For example, publications describing the implementation process of Product Ops in software organizations, and job postings from companies for Product Ops positions, were left for follow-up studies described in the discussion section of this paper. The search for more sources was paused when newly reviewed sources no longer added new information to the mind map, indicating reaching the required degree of knowledge saturation. Overall, 29 sources were identified and added to the spreadsheet. Of these, 3 were rejected, and 7 were left for follow-up studies. The review findings presented below were written based on the systematic analysis of the remaining 19 sources. The sources are mostly text-based (7 are web publications presenting an overview of the discipline, 2 are blog posts relaying personal experience, 6 are white papers, 1 is a written interview, and 1 is a book section), but also include 1 webinar and 1 podcast interview episode.

3 Results

RQ1: What are the definitions and schools of thought on the concept of Product Ops?

Several of the sources begin defining Product Ops through metaphors such as "*connective tissue between the teams building your technology and teams who interact with your users*" [Pe19a, Na22], "*the glue that helps move with unified energy to solve problems*." [Sa18], "t*he secret sauce to really making a product company run at scale*" [Ja22, Pe19c], or "*the secret weapon to keeping teams aligned and truly outcomedriven*" [Dr22]. The use of the term "secret" may indicate that for many organizations, this role is not yet familiar. Many publications make the analogy to other "Ops" roles in a company, including DevOps, Sales Ops, and Marketing Ops [Pr22a, Pe19a, Bu17]. Increased efficiency is the main focus — as one source puts it — Product Ops is "*applying the ruthless efficiency of sales operations to the R&D function*" [Pe19a]. Another describes the role as "*an efficiency engine dedicated to automating, streamlining, and optimizing*" [Pe18]. Other sources position Product Ops at the "*intersection of product, engineering, and customer success*" [Pe19b, Pr22a, Pe19a, Dr22].

Several reviewed publications state that the Product Ops role is "*different at every company*" [Pe19a, Ja22, Ca21], because the role is relatively new, and companies use it to address different needs [Pe19a]. But this, as Cagan points out, "*might be true, but isn't very helpful*" [Ca21]. A loosely defined Product Ops function is a risk that may lead to "weak" product managers delegating most of their decisions and losing ownership of the product strategy and roadmap [Ca21]. Still, publications reviewed indicate that companies benefit from a thoughtfully implemented Product Ops, especially when in an execution

mode (a term coined by Blank [Bl06] to describe the phase in a life cycle of a venture after a repeatable and scalable business model is found) [Ja22, Pe19c]. A clear definition would ensure Ops does not hinder the SPM function, but rather acts as a "*force multiplier*" [Ca21].

By studying, comparing, and summarizing the varying definitions and descriptions provided in grey literature, we developed the following definition:

> Product Operations (Product Ops) is a function that makes product companies more efficient and allows them to scale without friction. Product Ops empowers product teams in four ways:
>
> 1. Ensuring that software product managers regularly receive clean and reliable data to base their decisions on (**data management dimension**);
> 2. Managing the tooling, processes, and infrastructure used by the product team, establishing and communicating best practices (**tool and process management dimension**);
> 3. Allowing software product managers to focus on core SPM work by reducing the administrative burden and acting as a pro-active assistant (**operational complement dimension**);
> 4. Fostering cross-departmental and cross-team communication, collaboration, and coordination, ensuring alignment and preventing silos (**collaboration dimension**).

The four identified dimensions have the overarching impact of **optimization** and **alignment**. We elaborate on what exactly is optimized and aligned in our answer to RQ3.

RQ2: What are the responsibilities of Product Ops?

Four significant dimensions of Product Ops were identified in the analysis and included in the definition above. These dimensions also characterize the responsibilities. These are data management, tool and process management, operational complement, and collaboration.

Data management. One source describes data management as the "make or break piece of product operations" [Pe19a]. Product Ops is responsible for equipping product managers with reliable data, in order to support informed decision-making [Ja22, Ca21, Pr22b, Pe18, Dr22]. To achieve this, Product Ops must set up processes to collect qualitative and quantitative data about the product from across the organization. This includes conducting customer research, facilitating interviews and market research (at larger companies, this can be done in collaboration with a dedicated user research team).

Product Ops is involved in determining which users to talk to, how best to reach them, and what information in what format should be collected.

A commonly mentioned aspect is the management of data coming out of experiments [Pe19a, Ja22, Pr22a]. Product Ops standardizes the procedure of conducting experiments on products and features. This involves standardizing the format in which data is collected across different experiments and product teams. Product Ops is also supposed to track the status of planned and ongoing experiments, and sequence them in such a way that they do not interfere with each other's results [Pe19a, Ja22, Pr22a, Dr22]. One publication compares experiments to airplanes, and describes the role of Ops as "*running launch logistics on the ground*" and "*performing air traffic control*" [Pe19a].

Collecting data, however, is not enough. Product Ops is also in charge of organizing and cleaning the incoming data, and maintaining its integrity over time [Pe19a, Ja22, Pr22b, Pe19c]. Product Ops analyzes the collected data and looks for qualitative and quantitative insights that can be shared with product managers. Some practitioners describe this function as "*raising the data IQ of the broader product organization*" [Ca21] and adding "*more analytical horsepower to process data and gain insights*" [Bu17]. Product Ops ensures the data and insights they generate are known and considered by product managers when making strategic decisions. As one source puts it, the value of this product data and insights "*hinges on reaching the right people at the right time*" [Pe19a]. Product Ops ensures data such as customer feedback reaches the product team effectively and in a way that enables them to better meet customer needs [Na22]. For this, Product Ops must set up cadences and workflows for sharing the collected and analyzed data with stakeholders involved in product development [Pe19a, Na22, Pe18].

Tool and process management. Product Ops is responsible for managing the "tech stack" and infrastructure used by the broader product team. This includes instruments for product portfolio management, product design, user research, survey execution, and various collaboration and messaging tools [Dr22]. Product Ops learn how to use tools from various vendors, select the most suitable ones for their organization, and set them up [Pe19a, Ja22, Pr22a, Pr22b]. Once the tooling is configured, Product Ops educate product teams on how to use it, develop and communicate best practices for working with it by writing guides and conducting training sessions [Pe19a, Ja22, Ca21, Pr22b, Ha20, Dr22]. Product Ops become the source of best practices within the organization, and consult the team on various problems around workflows and tooling [Ca21, Ha20, Pe18]. If necessary, Product Ops communicate with the vendors of the tools directly to request changes or improvements, and manage the relationships with the vendors [Pe19a, Pr22b, Bu17].

Another aspect of the tooling dimension is automation. Product Ops automates product-related functions [Pr22b] and various repetitive and time-consuming tasks [Ja22, Ha20, Pe18]. For example, data correlation, analysis, and reporting can be automated to an extent [Pr22b, Pe19c]. Product Ops may also create new tools for product teams [Ja22, Pr22a, Ca21, Dr22]. As an example, the Product Ops team at payment processing software company Stripe has created a tool for product teams to smoothen the process of rolling out

new releases. By answering a set of questions about the scope, contents and maturity of the release, the team automatically receives recommendations about which cross-functional teams should be informed and involved in the roll-out of the release [Na22].

To determine whether the processes are working, Product Ops must also continuously measure the product development process, identify bottlenecks, and strive for more efficiency [Bu17, LS23]. This may include measuring the time it takes to roll out a release or launch a feature, as well as the number of features launched per quarter or per development sprint [LS23]. Product Ops may strive to keep this speed relatively consistent as the organization grows and the number of products, employees and customers increases [LS23]. A proper understanding of the organizational capacity to deliver prevents pursuing roadmaps that are overly ambitious [Pe19c]. Understanding the process allows Product Ops to also understand development costs. This lets them provide meaningful decision support to executives conducting a cost-benefit analysis of company initiatives [Pe18, Pe19c].

Operational complement. As the operational complement to product management, Product Ops is able to provide support and increase the impact of their counterpart. As organizations scale, the increased amount of customers, colleagues, products in a portfolio, and product data may become too challenging for product managers to handle alone [Ja22]. Introducing Product Ops to organizations means making a shift in task ownership [Pe19a] and redistributing the work [Pe18]. Product Ops take over the day-to-day tasks, including the aforementioned data management, market research activities, and team process establishment [Ja22]. This reduces the "*administrative burden*" [Pr22a] or the "*cognitive load*" [Ha20] on product managers and allows them to focus on core SPM work [Ha20].

One commonly mentioned responsibility of Product Ops is handling staff onboarding [Ja22, Pr22a, Ca21, Pr22b, Ha20, Dr22, Bu17]. Being in charge of establishing team processes and best practices, Product Ops is perfectly positioned to quickly bring new hires up to speed with the organizational dynamics and ways of working. Some sources suggest that Ops should also handle staff professional development by providing coaching [Pr22a, Ha20, Pe18, Dr22].

Finally, Product Ops may act as an assistant to product managers even outside their primary operational domain [Ja22, Pr22b]. One source describes it as "*simply an extra body familiar with the product and processes that can jump in when needed*" [Pr22b]. Some of the responsibilities of Product Ops at companies may be defined rather loosely, and professionals in those roles need to take the initiative when they identify the gaps they can fill to improve the overall product development experience [Pr22b].

Collaboration. Product Ops fosters cross-team and cross-departmental communication and collaboration. One source describes this as creating "*clarity on strategy across all levels*" [Dr22]. Product Ops ensures connections and communication channels between the product team and other teams [Pe19a, Ja22, Pr22a, Pr22b, Pe19c]. Product Ops

prevents silos by clearly and consistently sharing product-related ideas, data, and insights with teams outside the product team, and channeling data from other teams to the product team [Ja22, Ha20]. In larger organizations, cross-team dependencies can grow complex, and stall development [Dr22]. Product Ops is in charge of managing these dependencies between units and teams with the ultimate goal of improved coordination, alignment, and more efficient work across the board [Pe19a, Pr22a, Na22, Ha20, Pe18, LS23].

Part of Product Ops' responsibilities in the "collaboration" dimension is creating product documentation and becoming the best source of information about the product across the company. Product Ops set up internal knowledge bases accessible to all interested company stakeholders from a central place in a consistent way [Ja22, Pr22b, Na22, Ha20, LS23]. These central information hubs may contain educational materials about the product [Ja22], experiment results [LS23], the current state of the product in terms of quality and meeting the stated Objectives and Key Results (OKRs) [Pe19a, Pr22b]. Product Ops can also keep track of historical decisions made during product development to quickly bring staff and stakeholders up to speed and trace the justifications for the direction the product has taken [Ha20]. Another task for Product Ops can be to establish, document, and communicate the full context for reported problems, so that teams or individuals tackling these problems have a full understanding of the problem space [Ha20].

In addition to establishing information repositories, Product Ops must set up regular cadences to communicate this information across the organization. This involves scheduling regular cross-functional meetings [Pr22b, Na22, Ha20, Pe18], conducting product education for stakeholders [Ja22, Pr22b, Pe19c], and proactively sharing insights, status, and latest developments via announcements [Ha20]. All this leads to a scalable process where interested stakeholders can "*plug in when interested or needed*" [Na22, Dr22] for deeper engagement, but also remain "in the loop" from a distance.

RQ3: What outcomes or impacts can be expected when implementing Product Ops?

At this point we have established an overall definition of Product Ops and the responsibilities of Product Ops professionals in software organizations. Some of the benefits of implementing the function have already been alluded to. To fully answer this third research question, we formalize the outcomes and impacts of the Product Ops function across the four dimensions discussed above. The result is presented in Table 1.

For each of the four dimensions, the impacts are **optimization** and **alignment**. Optimization can mean accelerating certain company processes and initiatives, and more efficient use of resources. Alignment can mean improved coordination and communication between stakeholders and teams, and an improved shared understanding of the product strategy, current quality, and place on the roadmap. The optimization and

alignment across the four dimensions reduce the friction that companies experience when scaling up. Establishing a Product Ops function helps the companies prepare for or react to growth [Ha20].

	Optimization (Opt.)	Alignment (Algn.)
Data management	• Opt. of time to learn from and react to insights • Opt. of time to react to negative user feedback • Opt. of R&D costs by determining what to prioritize	• Algn. of development work with business outcomes • Algn. of experiment scheduling to prevent interfering with each other's results
Tool & process management	• Opt. of team work with tools tailored to specific team needs / company goals • Opt. of time spent on routine tasks by automation • Opt. of bottlenecks slowing down release times • Opt. of R&D costs by measurement and improvement of product development process • Opt. of overall financial performance	• Algn. of cadences and engagement rules to collaborate and share information with other teams • Algn. of the contents and the quality of inputs and outputs produced by teams, leading to more efficient collaboration and better outcomes
Operational complement	• Opt. of staff onboarding by following clear processes and documentation • Opt. of solving urgent problems by proactively jumping in to assist product managers	
Collaboration	• Opt. of cross-functional interactions and cross-team dependencies • Opt. of time it takes to carry out cross-team initiatives • Opt. of time it takes for stakeholders to get up to speed on product status • Opt. of effort to stay in the loop about the product status	• Algn. of strategy across all company levels • Algn. of stakeholder expectations by clearly and regularly communicating current status of products • Algn. of product teams distributed across the globe in larger organizations

Tab. 1: The Product Ops impact matrix

In the data management area, Product Ops cleans and analyzes incoming product data, and makes sure the data is available to product managers when making product-related decisions. Incorporating insights at regular intervals into the product development process improves the agility of product development teams. The teams are able to learn from the data quicker, and react to user feedback faster. Some practitioners refer to this as setting up "tight feedback loops" [Na22], systems to collect feedback and act on feedback [Ja22, Dr22]. Moreover, market and user research may indicate which aspects of the product need to be prioritized to achieve maximum impact, saving the time and therefore cost required to achieve the stated business goals [Ja22, Pr22a, Pe19c, Dr22, Sa18]. This ensures the work the product team is doing is in service of the business strategy, and helps quickly correct course when a deviation is discovered [Pr22a, Pe19c, Pe19a, LS23]. Furthermore, having a bird's-eye view of the experiments carried out by various product teams, Product Ops can sequence the experiments so that they don't interfere with each other's results [Pe19a, Ja22, Pr22a, Dr22]. This leads to more conclusive and reliable data coming out of experiments and influencing the decisions made by product managers.

In the tool and process management dimension, Product Ops optimizes the workflows of the product teams. Teams across the organization and members of the same team use a consistent set of tools, for which they have guides and documented best practices. Product Ops is always available to consult them on difficult problems [Ca21, Ha20, Pe18]. Product

Ops also templatizes and automates as many repetitive tasks as possible, making more time available for meaningful work [Ja22, Pr22b, Ha20, Pe18, Pe19c]. By constantly measuring and evaluating the product development process and studying cross-team dependencies, Product Ops can identify and tackle bottlenecks to accelerate the roll-out of features [Pe19c, Bu17, LS23]. Moreover, understanding the R&D costs, the business goals, and the needs and requests of various stakeholders lets Product Ops make informed suggestions on how best to prioritize development work for maximum impact [Dr22]. Increased alignment is achieved by establishing regular cadences for cross-functional meetings, as well as rules for when certain teams must be consulted and engaged [Pe19a, Na22, Ha20, Pe18, Dr22]. Product Ops establishes the format and the quality standards for the inputs and outputs produced by teams and departments in an organization, all in service of better outcomes [Pe18].

In the "Operational complement" area, optimization is the primary impact. New staff can get up and running quicker via a standardized and information-rich onboarding procedure. Product Ops are available as proactive assistants to product managers. Being familiar with the product domain and processes, they can assist in tackling urgent problems as they arise [Ja22, Pr22b].

In the "Collaboration" dimension, Product Ops optimizes cross-functional and cross-team interactions. This reduces the time it takes to execute initiatives that require several teams and departments to work together. Teams understand each others' schedules, have uniform communication channels, and exchange deliverables in a shared format. By setting up centralized information repositories about products, Product Ops reduce the time it takes for interested stakeholders to seek product information and get up to speed on the state of the product. Moreover, by regularly communicating research insights and product milestones, Product Ops reduce the time and effort for executives and others to stay informed on how the product is doing. This increased visibility across the organization increases the alignment of all units with the product and business strategy. Moreover, this ensures a clear shared understanding of the product, where it is on the roadmap, how well it meets quality standards, and what the users share about it. This prevents stakeholders from having unrealistic expectations or making unrealistic promises about the product. In larger organizations, teams distributed across the globe can also use the established information hubs and communication channels to share unique regional problems they may be facing. For example, high-speed network availability may be taken for granted in some areas of the world, but the lack of it may render a product hardly usable at other locations [Na22].

4 Discussion

Product Ops is a relatively new area in the software engineering and product management domain. It is an outgrowth of the spread of a variety of Ops functions across technology companies. While it is expected that implementing Product Ops would have a significant

impact on an organization's product development process, leading to a variety of positive outcomes, there is still much to be understood about how it can best be implemented and practiced in organizations.

Many reviewed grey literature publications focus on the positive impacts of implementing Product Ops, positioned as a kind of sales-pitch for the function. A degree of skepticism is therefore warranted, and a few authors do point out the possible risks of misunderstanding the role. One source of risk comes from the loose definition of the term. Cagan, for example, identifies six possible variations of "Product Ops" encountered in his practice, and considers some of those damaging [Ca21]. Specifically, in some cases, an older problematic role emerges under this new title ("*the reincarnated PMO model*"), and in others, product leaders delegate too much of their responsibility to the Ops function and lose ownership of the decisions about the product [Ca21]. In some cases, a different role that has existed for a long time is rebranded with the new title of Product Ops to attract professionals. This is the case with Production Operations (monitoring and maintaining the product post-launch) and Product Marketing Management, both of which are sometimes advertised as Product Ops [Ca21]. A study of job postings for the Product Ops position could further refine the definition we propose in this paper, and evaluate to which extent our definition encompasses the discipline. Another risk is that the overly empowered Product Ops function gatekeeps access to users and user feedback [Na22]. A healthy implementation does not prevent product managers from communicating with users directly, but rather sets up the system where SPM can rely on the research and insights provided by Product Ops, but can also connect to the customers, collect feedback, and run experiments personally whenever deemed necessary.

Publications seem to agree that the Product Ops function becomes more relevant for organizations after finding a product-market fit and beginning to grow [Ja22, Pr22a, Pe18, Pe19c]. Smaller companies may not need the role initially [Ja22, Pr22a]. A single person on the product team may be in charge of some of these responsibilities, or everyone contributes to an extent [Pr22a]. Introducing Product Ops for the sole reason of helping product managers handle "*too much work*" may indicate that product managers need additional coaching to cope with their responsibilities [Ca21].

Furthermore, the standardization and uniformity establishment function of Product Ops can become excessive, resulting in a bureaucracy that hinders innovation and becomes detrimental to productivity [Ca21, Na22]. This challenge can be viewed as drawing the line between chaos and bureaucracy [Na22]. Having experienced people with various backgrounds on a Product Ops team may help find the proper balance [Ca21, Na22]. The processes and practices must also be reconsidered over time as circumstances inevitably change [LS23] Still, if the aforementioned risks are navigated carefully, Product Ops can act as a "force multiplier" to its SPM counterparts [Ca21].

Quality bias is also a concern, as practitioners may miss important details, make bold claims, or manipulate the results to make them more appealing. Some of the reviewed publications are authored by companies and individuals who are involved in selling tools

and consulting services for software product managers and organizations. One could easily see the motivation for these sources to rally around a new discipline that involves educating companies on how it should be implemented, and the procurement and maintenance of tools for data and process management. But these sources are offset by seemingly neutral publication channels and positive examples from personal experiences.

Time frame bias is another possible issue since there may be a focus on short-term experiences due to the relative novelty of the concept, and not every included source is a longitudinal case or experience report.

In addition to source-related challenges, we as researchers may face selection bias if we failed to identify all relevant publications, or confirmation bias if we failed to summarize everything appropriately. In summarizing the grey literature findings, we focused on the aspects of Product Ops that fit into the "force multiplier" paradigm [Ca21] and emphasized the ways in which Product Ops can be helpful to SPM without hindering or taking over their core responsibilities. To balance this positive look at the discipline, we presented the possible risks in this discussion section.

Based on our grey literature review, we aim to shape a research agenda for Product Ops studies and research. This agenda could be a first step toward developing a strategic plan for guiding and focusing research efforts to help advance our understanding of this concept. Some possible key themes and areas of focus for further studies might include:

1. The aforementioned review and analysis of job postings for Product Ops to determine the expectations of the established players in the software industry.
2. The best practices and success factors for implementing the Product Ops function in software organizations, including the prerequisites, the timing, and the step-by-step guide to implementing the role. A research question may be formulated as "What factors contribute to the successful implementation of Product Ops?"
3. The various ways to structure the Product Ops team within organizations. Several options were already discovered during this literature review. Melissa Perri proposes one configuration ("the Perri model") [Pr22a, Pr22b, Pe19c], where a data-driven Product Operations Analyst takes charge of data analysis without deep domain experience, and a Product Operations Manager is more of a domain expert that works with the Analyst to streamline all processes and build organizational consistency. Another configuration is offered by Blake Samic ("the Samic model") [Na22], an expert who built the Product Ops function from the ground up at Uber and later at Stripe. In that model, a central generalist Product Operations Programs team establishes best practices, tools and processes for a variety of globally distributed Embedded Product Ops teams, who are deep domain experts in their product and region. These models should be studied and evaluated further, and other possibilities hould be identified. A research question may be formulated as "How Product Ops can be structured in software development organizations?".

5 Conclusion

In this study, we addressed the lack of a comprehensive definition and academic publications on the subject of the emerging discipline of Product Ops by conducting a grey literature review. Based on blog posts, white papers, interviews, podcasts, webinars, and magazine articles by practitioners, we proposed a definition of Product Ops, described the responsibilities of Product Ops in software organizations, and created an "impact matrix" describing the positive outcomes of implementing the Product Ops function.

Product Ops is a function that makes product companies more efficient and allows them to scale without friction. Product Ops aims to optimize the use of resources, and align product teams and company departments to ensure successful product development, delivery, and maintenance. The literature review has highlighted the potential benefits of Product Ops, including improved collaboration and communication between product teams and other departments, faster and more reliable software releases, and increased agility in responding to market changes. These benefits are realized by implementing standardized methodologies and processes. Additionally, the usage of automation, monitoring, and measurement tools can reduce human error and improve the speed and quality of software delivery.

However, Product Ops is not a one-size-fits-all solution. Its implementation should be tailored to meet the specific needs and goals of the organization, as well as the current skill set and culture of the team. Publications reviewed indicate that new companies often do not immediately require a Product Ops function. In smaller teams, a single individual may handle these responsibilities, or they can be distributed between all employees. After the company finds a product-market fit and grows, Product Ops can have a strong positive impact. Moreover, having inexperienced individuals on the team may result in the enforcement of overly rigid processes that are counter-productive. Having knowledgeable professionals with various backgrounds on the team, and reconsidering the established norms and practices over time based on ever-changing conditions, are named by practitioners as success factors towards a good implementation of the role. The introduction of Product Ops will usually shift the emphasis of the responsibilities of product managers, and it is important to clearly communicate the duties of both functions when implementing the role.

Overall, the reviewed grey literature suggests that Product Ops can effectively improve the product development process. Its potential benefits can be significant, but organizations should be aware of the potential challenges involved in its implementation. With careful planning and implementation, Product Ops has the potential to drive significant improvements in product development efficiency and effectiveness.

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A competency model for the Product Management in Software-intensive Business

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Abstract: As digitization continues, nearly all industries have become software-developing entities. The distinction between software companies and the manufacturing industry is becoming increasingly blurred. This poses major challenges, especially for the product management of companies. Once un-disputed competencies of a company are threatening to become irrelevant, while others are becoming more significant. This contribution takes this development into account, by examining the influence of the Software-intensive Business on the necessary enterprise competencies and deriving a competency model from it. This competency model forms the basis for a competency matrix that allows practitioners to measure the specific competencies of their enterprise and can provide implications for their improvement. The competency model and the competency matrix were evaluated by experts from several industries in terms of relevance and applicability.

Keywords: Software-intensive Business, competency model, product management, software product management

1 Motivation

"Software is eating the world. "[An11] This quote by Andreessen illustrates the current influence of software on products and entire industries. New markets are created by software and in almost all industries, digital products are enabled from formerly pure-ly physical products by adding software [He18, Ho19]. This turns nearly all companies into "Software producing organizations" (SPOs), [Mä18] which have to develop products and establish them on the market in a new type of business, the "Software-intensive Business" (SiB) [Ho19, Bo18, WBB18]. The analysis, planning, implementation and control of product development and ma[rket entry activities are classically carried out by product management organizations [Ho17]. New challenges for product management arise due to the shift from physical to digital products. In addition to the analysis of customer needs, product management must also consider the positioning of the product in software

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ecosystems and the planning of short development cycles [Ho19, Ho17, HO18, Rö18]. Adapted competencies are needed to deal with these requirements.

Competency models represent all those competencies required to successfully cope with emerging requirements in a specific context [RK18, Dg16] and can support organiza-tions determining which competencies are required to achieve the specified strategic goals. This also enables organizations in SiB to perform a comparison between exist-ing and required competencies [RK18, SS05]. In this way, competency models offer target-ed control of competency development in order to adapt the company to changing conditions and new requirements [Bi17].

The development and marketing of Software-intensive products is of outstanding importance for companies in order to continue operating successfully on the market and to gain new customers through products with inspiring functions. In order to establish or further develop a product management unit that is capable of meeting the requirements of SiB, a company must initiate measures for the targeted development of competencies. However, there is currently neither a competency model that companies can use to analyze necessary and existing competencies, nor an overview of competencies or a list of requirements that are placed on product management organizations in the context of SiB. Therefore, companies in SiB are currently only in a lim-ited position to control and develop the competencies of their product management units in a systematic and targeted manner. As a result, companies with a competence deficit develop and launch new products on the market without taking the require-ments of the SiB into account and thus run a high risk of failing or giving up deci-sive competitive advantages. Based on these findings, there is a need for a competence model that shows companies in SiB the required competencies of product management units and enables to compare them with their own competencies. The aim of this paper is to develop a competency model that enables companies to compare the existing competencies of their product management units with the competencies re-quired in SiB by answering the following research question:

RQ: How can a competency model for product management in Software-intensive Business be designed and made accessible for practice?

2 Related Work

As already explained at the beginning, software is progressively used in industries of formerly purely physical goods, but the service sector is also increasingly penetrated by software [Ho19, Hu18]. Software thus represents the decisive value driver and enables new business models [KF17]. Therefore, not only companies like SAP or IBM provide software products anymore, but also companies with originally purely physical products are increasingly becoming SPOs [Mä18]. This new type of business, in which software plays a vital role, is increasingly found in the literature under the term SiB.

SiB was defined in 2018 as a new research field that crosses information systems, software development, and business arises from the collaboration of researchers and practitioners at the 2018 Dagstuhl Seminar [ABB18, SGH20, Ja19]. A company in SiB "creates, captures, and delivers value through digital technologies" [WBB18] and companies in SiB "create value through the development of new software technologies. When operating a platform, they often capture value through their established network of partners. When a software is shipped to and operated by a customer, the value is delivered" [WBB18]. Thus, SiB considers value creation, capture and delivery based on digital products [ABB18]. In nearly all industries SiB ensures a shift in value creation, from the development, production and marketing of monolithic products to cross-industry business networks and collaborations [SSH18, Ac11]. The SiB can be divided into the following three areas: Software System, Human System and Ecosystem [WBB18].

According to Pepels, product management as an organizational form of structuring concerns the planning, organization, execution, and control of all activities involving the introduction, maintenance, replacement, or discontinuation of products [Ac11]. Product management thus represents an interface and coordination function that must deal with both internal company interface problems with other functional areas such as research and development or sales and interface problems with entities outside the company such as customers and suppliers. Homburg distinguishes four basic tasks of product management that make up the product management process: Analysis, Planning, Implementation and Control [Ho17].

Various authors subsequently transported product management into the software industry, considering its specifics [HP09, EB14, Pe14]. In addition to science, software product management (SPM) is attracting increasing attention in practice. In this area, a number of detailed frameworks and process models have been developed, which extend, process and detail the scientific findings. A well-known form of such frameworks that have emerged from practice is used in this paper as a starting point for the considerations and is briefly described below:

In cooperation with many product managers from various industries, the International Software Product Management Association (ISPMA) has developed a framework based on the three SPM frameworks of Utrecht, Ebert and Kittlaus [KF17, Eb14]. In this way, both the view of practice and that of science are considered [KF17, Fr12]. The resulting framework provides a complete view of SPM [KF17]. The structure and contents of the SPM framework as well as extensive explanations can be found in Kittlaus and Fricker (2017) [KF17].

The Steinbeis Institute's Enterprise Competence Check (UKC) is based on comprehensive research into existing competence models and competence measurement methods [Or17]. It represents a tool for the analysis of corporate competencies [Or17]. It includes 24 competencies that are measured in the check [Or17]. As a generic model, the UKC can be used for different companies and use cases. The competencies of the UKC include corporate or organizational competencies and are less focused on individuals [Or17]. As

this paper examines the competencies for product management in the context of SiB, as an organizational unit, and not the competencies of individuals in product management, the development of the competency model in this paper is based on the competencies of the UKC. A more detailed description of the UKC and its structure can be found in Ortiz (2016) [Or17].

3 Method

The procedure for the development of a competence model for product management in SiB in this paper is based on the Design Science Research (DSR) approach [PTR07, HMP04]. Here, the seven guidelines of Hevner et al. serve as orientation. These guidelines are: "1. Design as an Artifact 2. Problem Relevance 3. Design Evaluation 4. Research Contributions 5. Research Rigor 6. Design as a Search process 7. Communication of Research" [30]. In addition to these seven guidelines by Hevner et al., this paper is primarily oriented towards the process model developed by Peffers et al. (design sci-ence research methodology, DSRM) [PTR07]. Since in this paper an artifact in the form of the competency model is developed and subsequently transferred into a competency matrix for application in practice as well as validated, the DSR approach and the use of the DSRM procedure model appear suitable in this paper.

The special features of SiB with its subareas Software System, Human System and Ecosystem, present product management with challenges that can be formulated into more specific requirements. To meet these requirements, product management must have a certain set of quality characteristics. Enterprise competencies represent an im-portant subset of these quality attributes. These must enable product management to meet the requirements of the SiB.

To develop the competency model and achieve the desired goal, the requirements for product management must first be determined. (see Fig. 1). This is accomplished with the help of a comprehensive literature research.

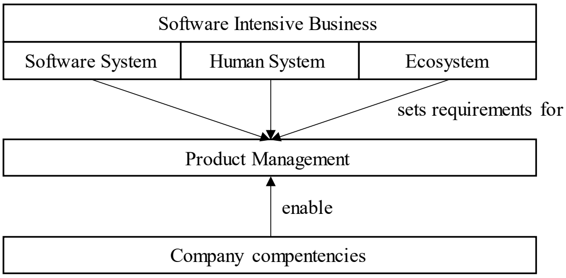

Fig. 1: Relationship between corporate competencies and product management in the SiB

This literature research is guided by the core activities of the SPM defined by ISPMA [15, 27]. In addition, the competencies contained in the UKC of Steinbeis Institute are used for the development of the competency model. Based on the obtained requirements and the identified competencies, the competency model for product management in the context of SiB is developed. For this purpose, the requirements are correlated with the competencies. To make the competence model accessible for practice, the model is transferred into a matrix and a questionnaire, which is presented to product management experts of different companies. By completing the questionnaire, companies will gain insight into the competencies needed in SiB. The questionnaire will also show the difference between the product management competencies needed in SiB and those available in the company. Furthermore, the applicability and relevance of the competency model for practice will be validated. This is followed by an evaluation of the results and an assessment of the competency model. In the following, it will be briefly explained how the procedure model of Peffers et al. is implemented in this work:

Identify problem and motivate: Companies must develop and market products in SiB successfully. To achieve this, product management units must have the necessary competencies to deal with the requirements of SiB. So far, no model exists that offers companies the possibility to compare their existing product management competencies with the competencies required in SiB in order to derive measures for an improved handling of the requirements. **Define objective of a solution:** The competency model aims to show which competencies are required by product management units in SIB. It is also intended to give companies the opportunity to compare the competencies available in their company with the competencies required in the SIB. **Design and development:** The competency model represents an artefact to be developed in this paper. The creation of the competence model is based on the obtained requirements of the SiB and the identified competencies. **Demonstration:** For demonstration purposes, the previously developed model will be prepared and transformed into a matrix for application in practice, which will be integrated into a questionnaire. **Evaluation:** To validate the competence model in terms of applicability and relevance in practice, the competence matrix is presented to experts of various industries in form of a questionnaire and evaluated by these experts. **Communication:** Publication of the results in this paper.

4 Competency Model for the Product Management in the SiB

The developed competence model comprises of two components: The first component represents 28 requirements that occur in the context of SiB for product management in companies. These requirements can be assigned to the three areas of SiB, the Software System, the Human System and the Ecosystem. Requirements in the software system mainly refer to the specifics of software, such as immaterial requirements [Ho19, HP09]. In addition, requirements are considered, that arise in the context of the definition of product properties or the business model around a product [MTL18, SSH18, JW18]. In

the field of the Human System, requirements could be identified that relate to interpersonal aspects, collaboration in temporally and spatially distributed teams, and to an agile orientation of an organization [Ho20, Sh14, KS18, HK20, Bl20, Hu18, Ac16]. Requirements could be assigned to the Ecosystem domain that depict collaboration and positioning in ecosystems and the associated opportunities and risks [Ho19, BSA13, VAH14, JH18]. Table 1 shows an excerpt of the 28 identified requirements.
In addition to these requirements, the competencies mentioned in the UKC of Steinbeis Institute were used as a second component [Or17]. The UKC distinguishes, in the context of the analysis of corporate competencies, four competence levels with six competence sections each. These four competence levels are differentiated into: Knowledge, Innovating, Implementing and Communicating [Or17]. A detailed description of the competency levels and the associated competencies can be found in Ortiz (2017) [Or17]. For the development of the competency model, generic competencies are necessary that can be applied to the specific context of product management in SiB, as an organizational unit. Since the UKC and its competencies can be used for different use cases and companies, and thus have a generic character, [Or17] these competencies represent an important component for the development of the competency model.

Area of the SiB	**Requirement**
Software system	Regular review and adaptation of the business model to changing conditions.
Human System	Make customer-specific information transparent for all parties involved.
Ecosystem	Knowledge about and positioning in possible roles in the ecosystem.

Table 1: Selected exemplary requirements to the product management in the SiB

To create the competency model, the identified requirements are correlated with the competencies. These correlations correspond to the degree of fulfilment of a require-ment by a competence and describes the intensity with which a competence contrib-utes to the fulfillment of a requirement. The development of these correlations and the structure of the competence model is based on the House of Quality (HoQ), as a com-ponent of Quality Function Deployment (QFD) [Ma20]. QFD itself is a customer-oriented quality method for planning and developing products and is defined in ISO 16355-1 [Ak92, Qf21]. The HoQ is a matrix representation that, in the context of QFD, contrasts customer benefits with the quality feature of a future product and relates them by evaluating the strength of the relationship between customer benefits and quality feature [HP09, Qf21, Sa11]. The HoQ then shows which quality feature fulfils which customer benefit, and to what intensity [Qf21, Sa11].

Analogous to the comparison of customer benefits and quality characteristics and their underlying matrix in the HoQ, requirements and competencies are compared in the competency model in this paper. The aim is to analyze which competencies are required by companies to satisfy the identified requirements. On the Y-axis of the matrix, the identified requirements are plotted according to their assignment to the three fields of the SiB. On the X-axis are the four competence levels of UKC, with their associated competencies. In the center, the degree of fulfillment of a requirement is represented by the competencies. The analysis of the influence a competence has on the degree of fulfilment of a requirement is based on the question "What influence does competence X have on the fulfilment of requirement Y?" and is differentiated into zero (no influence), one (weak influence), three (strong influence) and nine (very strong influence). This rating is also based on the scale of correlations in the HoQ [La20, Is15]. Figure 2 shows the general structure of the competence model for product management in SiB.

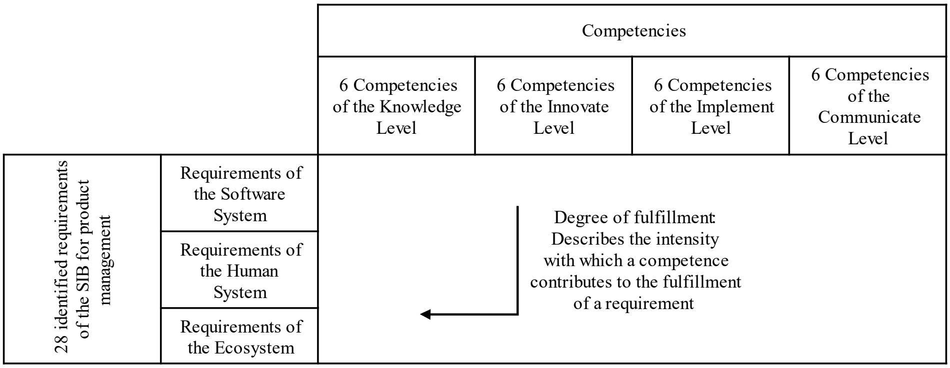

Fig. 2: Structure of the competency model

5 Evaluation

5.1 Demonstration

For usage and validation, the developed competence model must be made accessible to practice. For this purpose, the generic competence model is specified as a so-called competence matrix for application in practice. As described above, the competency model represents the degree to which the product management requirements in the SIB are met by the various corporate competencies. The competence matrix based on this enables practitioners to evaluate its own competencies in form of a target-performance comparison with regard to their suitability for product management in SiB and to identify potential for improvement. A questionnaire was developed for the application of this competence matrix in practice.

The purpose of this questionnaire is to show the differences between existing competencies of enterprise’s product management units and the competencies needed in the context of SIB. To this end, the comparison between the target and actual state of product management competencies is carried out. On this basis, companies can develop measures to build up or reduce competencies.

For the formation of the competence matrix, the competence model is augmented by the specific competencies contained in the UKC [Or17]. These competencies are cor-related with the requirements, as shown in the figure below. This figure includes an extract of the matrix consisting of requirements (Y-axis) and competencies (X-axis) as well as the resulting degree of fulfilment of a requirement.

	Competence X has a ... influence on the fulfillment of requirement Y.	**Competence Level Knowledge**					
		Resources			**Learning**		
		Technical / methodical knowledge	Technologies	Property Rights, Patents, Licences	Flexibility / Adaptability	R&D	Problem Solving skills
Human System	Ensure coordination & optimization of collaboration for spatially/temporally distributed teams.	1	0	0	9	1	1
	Implement agile forms of organization.	9	0	0	3	1	0
	Make customer-specific information transparent for all stakeholders	1	0	0	0	0	0
	Make the shared product vision internally transparent.	0	0	0	0	0	0
	Consider social networks in customer interaction & marketing.	0	0	0	0	0	0
	Ensure balance between time-to-market & pressure for the development team.	0	0	0	1	1	0
	Implement close coordination with development.	1	1	0	0	3	0
	Identify customer excitement requirements.	9	0	0	0	1	1
	Understand effect of requirement on customer.	3	0	0	0	1	1
	Putting the customer & success critical stakeholders at the center of product development.	3	1	0	0	3	0

Fig. 3: Extract of the developed competence matrix

The questionnaire submitted to professionals of various industries to asses the company’s own product management competencies is based on an Excel document consisting of several spreadsheets. Spreadsheet 1 contains all relevant information needed by the survey participant to complete the questionnaire. Spreadsheet 2 con-tains the first questionnaire. Within this questionnaire, the identified requirements, based on their importance to the respondent's business, are rated. The rating follows the statement "The requirement is important for product management in our compa-ny..." and has the following five response options: 0: not important at all, 1: rather unimportant, 2: neutral, 3: rather important and 4: very important. The experts’ rating of a requirement is multiplied by the respective correlation between requirement and competence in the background, based on the developed matrix. Starting from the products, column-by-column sums are formed for each competence. This results in values for the 24 competencies, based on the importance

of a requirement for the company of the expert surveyed and the correlations behind it, which represent the target state for the respective competency in the product management of the company. The following figure shows a simplified calculation of the target value.

Competencies

Information from the experts

Correlations of the competence model

Identified requirements

Identified requirements	Importance evaluation	Learning: Flexibility/ Adaptability	Learning: R&D	Learning: Problem Solving skills
Meeting & validating high-risk assumptions with customers.	4	3	3	3
Identify & adapt new trends.	2	3	9	3
Dealing with complexity in the product portfolio.	1	1	9	1
Putting the customer & successcritical stakeholders at the center of product development.	3	0	3	0
Turning disruptive innovations into market-ready products.	0	1	9	1
Column sum		**19**	**48**	**19**

Example calculation for the competence Flexibility/Adaptability 4*3+2*3+1*1+3*0+0*1= 19

Fig. 4: Simplified calculation of the target value

Spreadsheet 3 comprises the second questionnaire. In this questionnaire, the same requirements are assessed again by the respondents. This second assessment questions to what extent the requirements are already fulfilled by the product management of the surveyed company and follows the statement "The requirement is...fulfilled by the product management in our company." Analogous to questionnaire 1, the following five answer options are available: 0: not at all, 1: rather not, 2: neutral, 3: good and 4: very good. Similar to questionnaire 1, column sums are also formed here. The values calculated from this represent the actual state of the respective competence in the product management of the company. The fourth spreadsheet contains the evalua-tion for the respondents. This evaluation includes the previously calculated target and actual values in the respective competence areas. In addition to the calculated target and actual values, the evaluation also includes the difference between the actual and target values. The difference is calculated as follows:

"Actual value of competence A" - "Target value of competence A"

Positive differences indicate a competence surplus (actual > target), they are colored green in the evaluation. Negative differences indicate a lack of competence (actual < target) and are colored red in the evaluation. The greater the difference between target and actual value, the stronger the intensity of the respective coloring. For a better understanding of the results, the last table sheet contains an overview of all compe-tencies with short explanations of the most important contents.

Based on this Excel document and the presented spreadsheets, the competence model is made accessible for various industries and offers companies the opportunity to evaluate the actual and target state of the product management competencies re-quired in SiB within their company. Based on the differences in the evaluation, com-panies should be encouraged to gain and implement measures to build up or reduce competencies in order to meet the SiB requirements that arise for product manage-ment.

5.2 Evaluation in practice

To validate the relevance and applicability of the competency model in practice, the competency model (based on the questionnaire explained in Chapter 5.1) was presented to product management experts from various industries as part of a qualitative survey. All the experts surveyed work in product management in their company. In order to validate the competency model in as many different industries as possible, care was taken when selecting the respondents to ensure that they differed according to the type of industry in which they work. Differences in terms of the size of the companies surveyed were also considered, based on the number of employees working in a company. Twelve experts were contacted for this purpose. The response rate to the questionnaires was 50 percent. Table 2 provides an overview of the industries in which the experts surveyed are active and how many employees their company has. The table only takes into account the experts who returned the completed questionnaire.

#Expert	Industry	Number of employees
1	IT	1,000
2	Automotive	235,000
3	Financial Services	150,000
4	Energy	12
5	Automotive	400,000
6	Automation	20,000

Tab. 2: Overview of the experts interviewed

To be able to specifically draw statements regarding the relevance and applicability of the competence model for practice, the respondents were presented with a further questionnaire after completing the first two questionnaires. The evaluation within the framework of this questionnaire is based on a five-part scale: "The statement ... 1: does not apply at all, 2: rather does not apply, 3: neutral, 4: rather applies and 5: fully applies." The complete questionnaire for assessing the applicability as well as the relevance of the

competence model for practice can be viewed at the following URL: https://bit.ly/3nZucMJ

The relevance of the competence model was evaluated positively by the respondents. This result is primarily due to the evaluations of the statements "I see the relevance of the requirements for my company", "The topic of Software-intensive Business is relevant for our company". Another predominantly positive assessment was that the competency model can support executives in understanding the necessary competencies and matching them with existing competencies, as well as that it provides added value to the respondents. Added value results from the clear presentation of the differences between target and actual values. It is also noted that the competency model can be used to derive content for job advertisements.

In addition to relevance, the applicability of the competence model is also rated positively. This is based on the positive evaluations regarding the comprehensibility of the requirements as well as the logical and comprehensible structure of the Excel document. Most of the respondents state that they have sufficient insight into their own company to be able to make a meaningful assessment.

Comments from the experts show that further requirements, e.g., around data analytics, should be included in the competence model. It was also noted that transferring the competence model into an online tool would make it easier to use and evaluate. While all respondents found the outcome of the competency model interesting, they were not surprised by the result. This can be attributed to the fact that the majority of respondents believe they have sufficient insight into their company to be able to make a meaningful assessment and therefore already have knowledge of competence differences.

6 Discussion

With the achieved results, the present work considers the research agenda of the SiB by contributing to closing the research gap regarding the management of software-intensive products [Ki18]. Nevertheless, the results are associated with some limitations regarding the significance, which will be pointed out in the following.

The identification of the requirements is based on literature research, which is based on a keyword search and the method of concentric circles. The concentric circle method can only identify sources older than the original work, which means that there is a risk that current sources have not been taken into consideration in this work. By adding a keyword search to the literature research, this risk was reduced and current work was identified on which to base this paper.

Furthermore, the correlations between the competencies and the requirements are based on information from the literature and the authors' assessments. These correlations

represent a crucial factor in the competency model, which is why the varification of the correlations should be validated by product management experts in practice.

The competence model could be made accessible for practice with an Excel document. However, the feedback from the experts shows weaknesses in the application of the competence model. Therefore, the competence model should be transferred into an online tool to make it more user-friendly.

The results of the survey confirm the practical relevance and applicability of the competence model developed in this paper. However, the validation of the competence model is based on a qualitative survey. The findings of this survey are therefore not generally applicable to all company contexts, even though an attempt was made to make a cross-section of companies from different sectors and of different sizes. In order to improve the general validity of the statements, the competence model should be presented to further product management experts from practice, within the framework of a quantitative survey. The transfer of the competence model into an online tool described above can support making the competence model accessible for a quantitative survey of many different companies.

7 Conclusion

With this work, a first step towards improving product management in this increasingly important industry was made by designing a competence model for product management in the SiB. With the competence matrix based on it, practitioners were also given a helpful tool for improving their own product management. By using the competence model and the competence matrix, companies can record and evaluate their product management competencies and derive measures for improvement based on the results. This enables product management units in companies to develop and market competitive, software-intensive products to ensure the sustained success of the business.

This work can thus form the starting point for further considerations of product management competencies in SiB. The data collection within this paper showed that there is further research potential, especially regarding the requirements of the SiB for product management. Exploiting this potential should be the aim of future research. Furthermore, in the rapidly changing context of SiB, requirements have a dynamic character and change over time. Therefore, the requirements and their relevance should be continuously validated to ensure keeping them complete and up-to-date.

The competence model in this paper shows companies differences between the target and actual state of their internal product management competencies. In order to provide companies with recommendations for action based on this evaluation, a framework of general measures for building up or reducing competencies should be defined for the individual competency areas. These general measures can support companies in deriving company-specific measures.

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Helferich et al. (Hrsg.): 1st International Conference on Software Product Management,
47 Lecture Notes in Informatics (LNI), Gesellschaft für Informatik, Bonn 2023

What Got You Here Won't Get You There

A multi-case study on the challenges in the transition from traditional towards continuous data practices in the embedded systems domain

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Abstract: For decades, product data has been collected and used for quality assurance, for post-deployment defect detection and for informing the next generation of products. Across industry domains, and with the online domain leading the way, companies have adopted experimentation and data driven practices such as A/B testing to evaluate product performance, customer behaviors and for determining what adds value to customers. However, with the rapid changes that new digital technologies bring, companies are moving towards continuous value delivery and monetization models in which they offer their products as-a-service or offer services to complement and extend their existing products. In this transition, the traditional way of post-deployment data collection and use is no longer sufficient. While companies realize this, they experience difficulties in making the changes they need to transition towards continuous practices and new ways of working with data. As a result, companies risk wasting development efforts on functionality that have little or no customer value and they lose out on the competitive advantages that come with insights derived from continuous collection and use of data. In this paper, we explore the challenges companies experience in the transition from traditional towards continuous practices and the implications this shift has on their ways of working with data.

Keywords: Digitalization, digital transformation, data practices, continuous practices, continuous customer value delivery.

1 Introduction

Due to digitalization and technologies such as software, data, and artificial intelligence (AI), companies across domains are experiencing a fundamental shift in how to develop, deliver and monetize customer value. As recognized by e.g., [BO21], [PH14], [HE18], [OS22], digital technologies and digitization of products allow companies to expand and improve value creation in their existing products at the same time as they can provide customers with entirely new value in the form of e.g., data-driven service offerings and digital products. With the many opportunities to collect and leverage data generated by products in the field, companies are focusing their efforts on exploiting this data for

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competitive advantage [PF13]. By collecting, processing and actively using data generated by connected products, companies can advance not only their software engineering practices and their products, but also the understanding of their customers and what adds value to them. For companies in the embedded systems domain, software is rapidly becoming the central differentiator, whereas the traditional technologies such as mechanics and electronics are becoming commodities [Bo15], [BO21], [OB20]. With value creation being shifted from hardware to software, these companies experience a situation in which they can update and continuously improve their products after manufacturing and deployment at the customer. While this significantly extends the lifetime of a product and the experience of the customer, it also allows for new digital business models and recurring revenue streams [BO21], [Ge20], [LP15]. For decision-making, the increasing availability and access to data allows for entirely new ways-of-working characterized by data-driven approaches to e.g., feature prioritization, customer validation, and product and service innovation. As examples, companies that used to be heavy on waterfall approaches to development are adopting iterative and customer-centric methods such as design thinking and lean start-up to understand and empathize with customers [BO21], [CF18], [DP19]. Moreover, techniques such as A/B testing and feature experimentation are being explored to continuously evaluate and improve customer value [Fa17], [Fa17], [Is21], [Li21].

However, with the rapid transition towards continuous value delivery and monetization models, the traditional way of post-deployment data collection and use is no longer sufficient. Although companies realize this, they struggle in making the changes they need to transition towards continuous practices and new ways of working with data. In this paper, and to address this problem, we explore data practices in embedded systems companies. Based on multi-case study research, we explore the challenges companies experience in the transition from traditional towards continuous practices and the implications this shift has on their ways of working with data. The contribution of this paper is three-fold. First, we identify the key challenges that companies in the embedded systems domain experience in the transition towards continuous data practices. Second, we derive four organizational anti-patterns that we see reduce the benefits of data practices in large software-intensive embedded systems companies. Third, we provide a set of recommendations to help companies evolve beyond their current state.

The remainder of the paper is structured as follows. In section 2, we review literature and related work on digitalization and data practices. In section 3, we describe the research method that was adopted in the study. In section 4, we present our empirical findings, and we identify the key challenges the case companies experience. In section 5, we derive four organizational anti-patterns that we see reduce the benefits of data practices in software-intensive embedded systems companies and we provide a set of recommendations to help companies advance their current data practices. In section 6, we discuss threats to validity. Finally, in section 7, we conclude the paper, and we outline opportunities for future research.

2 Background and related work

2.1 Digitalization and digital transformation

At the core of digitalization and digital transformation is the opportunity for continuous value delivery to customers. Technologies such as software, data and AI transform the ways in which business entities operate, how they create value and how value is delivered and monetized with customers. According to [MHB15], digital transformation brings the opportunity for increases in sales and productivity, innovations in value creation, as well as novel forms of interaction with customers. In previous research, data is recognized as a key component to innovations and opportunities for new value creation and monetization [BO21], [BZN15], [IV19], [Kr22], [MHB15]. In [BZN15], data is referred to as the "new oil" and capitalizing on data is described as increasingly important for a business to remain competitive. As recognized in this research, businesses are developing new business models specifically designed to create additional business value by extracting, refining, and capitalizing on data. Similarly, in [KB19], the authors refer to data-driven business models as service-oriented business models which use data as key for new value propositions to customers. In our own previous work [BO21], we study how companies are transforming towards digital companies and how data is critical in this evolution. Also, we outline how data is becoming an asset as the basis for data driven and digital services allowing for recurrent revenue streams [OB22]. As examples of such services, data is used to provide insights, recommendations, and actions to customers. As a next step, data from customers can be aggregated and used to provide comparative analysis and insights. However, in the transition towards continuous practices, the traditional and often ad-hoc way of data collection is no longer sufficient [OB13]. In the following sections, we describe data practices and how these practices are shifting in character. As recognized in previous research, this shift brings numerous opportunities, but also challenges as companies need to adopt new ways in which they work with data.

2.2 Data practices

The collection and use of data in embedded systems companies is not a new phenomenon. Previous research has described the many benefits with using data as the basis for e.g., feature prioritization, for understanding feature usage, for innovation purposes, and for decision-making in organizations [BE12], [OB14], [Ro20]. If looking at the online domain, data practices such as A/B testing and feature experimentation are used on a continuous basis to learn how the introduction of new features affect user experience, satisfaction, and system performance [Fa22], [Fa17], [KT17]. In [Au21], the authors describe how decisions regarding what features to build are difficult for software development organizations and that the effect of an idea and its return-on-investment might not be clear before its launch. Moreover, the evaluation of an idea might be expensive. In most organizations, this leads to a situation in which decisions are taken

based on opinions and experience and on assumptions on what adds value to customers. With A/B testing, organizations can evaluate different versions of a software feature and collect data on which version performs the best [De17], [KTX20]. Based on this, data driven decisions can be taken regarding future development, improvement, and optimization of features. In [RBR22], A/B testing is described as an experiment-driven software engineering approach where assumptions about product features and requirements are continuously tested with users with the intent to reduce the risk of wasting development resources on requirements of little or no value to users. Similarly, [Da21], [Fa17], [Is21], and [OB14], recognize how use of data for experimentation purposes helps companies in the embedded systems domain minimize the risk of developing software that does not deliver value to customers. However, despite well-known benefits, the adoption of data driven practices is relatively slow. While the opportunities are many, the transition towards fully automated data practices requires not only new techniques and tools but also architectures and infrastructures as well as new competences and skills [Li21].

2.3 Towards continuous data practices

To realize the opportunities that come with continuous value delivery, companies are increasingly adopting continuous practices. For years, companies have been adopting DevOps practices. In [Mu20], DevOps is defined as a set of practices that helps to build a collaboration between software development and operations which reduces the software development lifecycle and helps in continuous and fast delivery of high-quality software. With DevOps, customer value is created in short cycles and deployed on a frequent, or even continuous, basis [Lw16]. Similarly, DataOps is a practice which aims at bridging the gap between data and operations teams and is viewed as an application of DevOps but for data analytics [Mu20]. DataOps practices are viewed as effective means to help companies make meaningful use of data and for keeping track of data and the purpose for which it was collected [BZ12], [Fi21]. In a report from Gartner, DataOps is described as a collaborative data management practice with the goal of delivering value faster by creating predictable delivery and change management of data, data models and related artifacts [DO23]. For companies in the embedded systems domain, DataOps is one of several continuous practices that support continuous value delivery to customers but that requires a fundamental shift in how these companies work with data. In what follows, we present a study in which we explore the challenges embedded systems companies experience in the transition from traditional towards continuous practices and the implications this shift has on their ways of working with data.

3 Research Method

The research presented in this paper is part of a long-term collaboration between 17 companies in the embedded systems domain and five Swedish universities (www.software-center.se). For more than a decade, we have had the privilege to engage with these companies in case study research [Ea08], [Ma12] within the field of software engineering. The companies represent different domains, and they share the similar experiences of digital transformation and the challenges and opportunities that come with new technologies such as software, data, and AI. Currently, all companies are exploring data practices and how to benefit from these. In this paper, we report on on-going research that was initiated in January 2022 in which we explore data practices in a selected set of the companies. In alignment with our research interests, we adopted a qualitative research approach with case studies as our method. Case study research is well-suited for research concerned with identifying patterns of action and for studying organizational contexts in which emphasis is put on stakeholder's perceptions and experiences [Ea08].

3.1 Case companies

As our empirical basis, we selected a set of primary and secondary case companies. As described in [Ge09] and [SG08], case study selection is critical as case study research is about something larger than the cases themselves. Typically, the chosen cases are asked to represent a population of cases that is larger than the cases themselves, and therefore, background cases play an important role for analysis. In accordance with this, the empirical findings we present build on research in three companies that were selected as primary cases. As secondary cases, we selected three companies that experience opportunities and challenges very similar to the primary case companies. The three *primary case companies* are briefly described below:

Case company A: A company providing product development, marketing, engineering, sales and support for crew planning and optimization. For this paper, we engaged with a team involved in development of new service offerings and roles representing software, architecture, and portfolio.

Case company B: A company manufacturing trucks, buses, and construction equipment as well as a supplier of marine systems. For this paper, we engaged with a team responsible for new service innovation and development.

Case company C: A company developing autonomous driving and advanced driver-assistance systems. For this paper, we engaged with product owners in areas such as fleet insight, data driven data management and data governance, as well as roles involved in business development and strategy.

In addition to the three primary case companies, we studied three *secondary case companies:*

Case company D: A company developing pump units, circulator pumps, submersible pumps, and centrifugal pumps. For this paper, we engaged with roles responsible for product management, sales, and architecture.

Case company E: A company manufacturing network cameras, access control, and network audio devices for the security and surveillance industries. For this paper, we engaged with roles responsible for software development, architecture, platform development, engineering, and management.

Company F: A company providing networking and telecommunications solutions and services. For this paper, we engaged with roles in management and software engineering.

3.2 Data collection and analysis

For data collection, we engaged in workshop sessions with both the primary case companies and the secondary case companies involved in our study. These workshops were organized either online or at the different company sites and gave us the opportunity to meet with key stakeholders in teams involved in, and responsible for, data collection, data analytics and data usage. Although our research collaboration with these companies covers more than a 10-year period, the study we report on in this paper was initiated in January 2022 and is on-going. During 2022, we organized on-site workshops at all primary case companies (company A, B and C) and at the three secondary case companies (company D, E and F). In addition, we met with all case companies in online workshops. The on-site workshop sessions lasted for 2 – 4 hours and involved 4 – 8 people. The online workshop sessions were typically shorter (30 minutes – 1-hour sessions) and a way to follow-up, share ideas and results and for monitoring progress in between the on-site meetings. In total, the research we report on in this paper is based on 12 on-site company workshops and 18 online workshops. In addition to these workshops, we met with both the primary and the secondary case companies at *two larger cross-company full-day events* that we organized to report our preliminary findings and get company feedback. As this research is on-going, we have company workshops with all case companies scheduled during spring 2023 and our intention is to scale the interactions with the secondary case companies. For data analysis, we adopted an interpretive approach [Ea08], [Ma12], [Wa95]. As suggested by [Wa95] the generalizations that are made based on case study research are valuable for other organizations that experience similar challenges in similar contexts to the case companies.

4 Empirical findings

For decades, the case companies involved in our study have harvested huge amounts of data from e.g., development and test fleets, from internal systems, and from products in the field. They have sophisticated infrastructures and systems in place for adding events,

enabling queries and questions, and for introducing and monitoring metrics. So far, the data has been used primarily for quality assurance of products, for post deployment defect detection, and for informing the next generation of products. However, due to digitalization and the many opportunities that come with new digital technologies, the companies are experiencing a rapid shift from traditional and product-oriented business models towards continuous and service-oriented business models. In this transition, the traditional, and often ad-hoc, way of post-deployment data collection and use is no longer sufficient. Instead, all the case companies seek to adopt new and more continuous ways of working with data. This implies a shift towards periodic and, in the end, continuous and automated collection, processing, and use of data.

Below, we identify the *key challenges* the case companies experience in the shift from traditional towards continuous data practices. We structure our findings according to generic challenges that are prevalent both in traditional and continuous practices and challenges that we identify as unique for continuous data practices.

4.1 Generic challenges that are prevalent in both traditional and continuous data practices:

Combining qualitative and quantitative data: Both the primary and the secondary case companies involved in our study experience challenges with how to effectively combine different data sources. This involves how to generate insights that build on both qualitative data generated within the company, and quantitative data generated by products in the field. In traditional data practices, organizations rely heavily on individuals to collect, process, and analyze data based on requests from e.g., product management or from development teams. Often, such requests are ad-hoc requests concerning a specific feature and its behavior and requires manual efforts in identification and analysis of relevant data. In the shift towards continuous practices, companies need automated solutions that help convert qualitative data into quantitative data to enable frequent monitoring and control of the data analytics pipeline. As a common challenge in our case companies, people report on difficulties in e.g., combining feedback from customers with data from internal build systems (continuous integration and continuous deployment systems) and data generated by products in the field. While customer feedback typically reflects qualitative experiences of the overall system and individuals' perceptions on usability, build system and product data reflects quantitative measures of internal efficiency and performance.

Incorporating external data with internal data: Throughout our study, we learnt that the case companies experience difficulties when trying to incorporate external data produced by third parties, and other relevant data sources generated outside company boundaries, into their own data streams and as a complement to their own data sources. For example, while sources such as e.g., market trend data and social media data are viewed as sources that provide potentially valuable insights about customer behaviors, these are also perceived as more challenging to keep accurate to avoid invalid or inaccurate data. As companies are moving towards continuous data practices, one of the main

challenges is to ensure that the time and period of the internal data is aligned with the time and period of the external data.

Understanding the surrounding context of a metric: Although the case companies have a large set of metrics in place in their systems, they lack effective mechanisms that help them understand the surrounding context of a specific metric. For example, a metric can capture a certain action taken by a user but very often information such as when the activity took place, who initiated and performed the action, what the purpose or use case of the action was etc., is missing. As a result, the analysis of what a metric reflects becomes difficult as the context of the data that is collected is lacking. For example, one of the primary case companies describes a situation in which the same metrics are used to capture two user groups with very different behaviors. While one customer group interacts with the system on a very frequent basis for solving highly complex optimization tasks, the other customer group uses the system to perform basic tasks and with as little interaction as possible. Metrics are the same however, and during one of our workshops one of the product managers described the situation as *"…comparing apples and pears"* referring to the same metrics being used to capture two very different use cases and user scenarios.

4.2 Challenges unique for continuous data practices:

Limited scope of metrics: In the transition towards continuous data practices, the scope of metrics becomes increasingly important. While metrics in traditional data practices tend to focus primarily on performance and quality aspects of the system, metrics in continuous practices need to capture not only a certain aspect at a certain point in time, but also how aspects of the system change over time. In our study, the case companies report on challenges with regards to the scope of metrics and how to ensure that existing metrics capture accurate data on e.g., frequency, rate, duration, or interval of an event. Especially, the case companies experienced challenges with regards to how to continuously integrate changes in data while maintaining and ensuring high quality of data.

Metrics are "static" and viewed as "cast in stone": In the case companies we studied, metrics tend to show feature usage in terms of activation of the feature rather than providing insights that capture usage patterns, complexity of a user task, purpose of use or how feature usage changes over time etc. Most often, metrics represent the behavior of a feature or of a system as it was once specified in a requirement (static), rather than providing an understanding of what the feature or system should do and what could be expected from it in its evolution (dynamic). In addition, and as experienced in most of the case companies, people at different levels and in different functions often view metrics as "cast in stone", leading to a situation in which the introduction of new metrics, experimentation with metrics, and removal of existing metrics is regarded very difficult even if this is key for continuous data practices.

Monitoring overall improvement: All case companies have DevOps practices in place and periodic deployment of software allow them to continuously measure and monitor

basic key performance indicators (KPIs). However, we noticed that despite this, the companies often lack mechanisms to determine if things are overall improving or not. In several workshops, teams reported how they continuously improve specific features and how they can monitor these improvements over time. Still, they are unable to understand to what extent, or if at all, the feature improvements they do contribute to an overall improvement of the system. In our experience, this is due to an unclear desired state meaning that teams and organizations don't know, or don't align, on what they are optimizing for. Also, slow customer activation of frequently deployed software functionality makes it difficult for continuous monitoring of overall system improvement. As one example, one case company experiences a situation in which the data coming back from their products is so complex that most developers have difficulties in understanding it. In one of our onsite workshops, one of the key stakeholders reflected on this and described it as "*You either have hardware people or you have software people but to combine these skills are hard. In addition, we have a problem with granularity as there are so many variables and factors that interact."* For the company, this results in a situation where teams track a sub-set of metrics but where improvement of overall system performance is more difficult to monitor. This situation is valid also for the other case companies as they all report on difficulties in fully benefitting from the data they have available. Often, there is little agreement on what KPIs are the critical ones and hence, how team and feature level metrics correspond to high-level business metrics. Also, one problem is that initial data collection is often concerned with a specific use case while continuous improvements of this use case might make the case for analytics a different one and therefore, contextual data is required to fully benefit from data and analytics as mechanisms to monitor overall system improvement.

5 Discussion

5.1 Organizational anti-patterns

As reported in this paper, the use of data practices is challenging for companies with systems involving not only digital technologies but also mechanics and electronics. As a generalization of what we see happen in the case companies, we derive four anti-patterns that reduce the benefits of data driven practices in large-software-intensive embedded systems companies. An anti-pattern in software engineering, project management, and business processes is a common response to a recurring problem that is ineffective and that risks being highly counterproductive [Ga95]. In both the primary and the secondary case companies, we see the following anti-patterns (Table 1):

Anti-pattern:	**Description:**
The "worthwhile many versus the vital few" anti-pattern[1]	The lack of a shared understanding of the desired state makes prioritization and resource allocation difficult. This results in individuals and teams spending time and efforts on activities that don't directly contribute to business value and success.
The "homonym" anti-pattern	Companies fail to realize that they use the same metrics to capture two (or more) different customer groups with different preferences. This results in difficulties in analyzing and benefitting from any data that is collected, as well as an inadequate metrics system reflecting only a subset of what it potentially could.
The "what got you here won't get you there" anti-pattern	KPIs reflect requirements that was once accurate and that describe feature and system behavior but that have stopped being true. This results in an insufficient metrics system reflecting current state but that fail in capturing desired state, i.e., what the feature and system should do and what we expect from it over time.
The "Alice in Wonderland – if you don't know where you're going, any road will take you there" anti-pattern	The lack of a desired outcome and agreed upon key value factors make individuals and teams optimize for their own best but without a holistic understanding of the business. This results in conflicting KPIs, suboptimization of team efforts, and misalignment in business outcomes.

Tab. 1: Anti-patterns that reduce the benefits of data practices.

[1] The 'vital few' is a term is derived from the 80-20 rule (the Pareto principle) which asserts that about 80% of all outcomes are the direct result of only 20% of all inputs.

5.2 Recommendations

In this section, we provide a set of recommendations with the intention to help companies advance their data practices and evolve beyond their current state. The recommendations are inductively derived based on the insights we gained during this study, and during our long-term collaboration with the case companies. To further advance data practices in software-embedded systems companies, we recommend the following:

Experiment with proxy metrics that are indicative of customer value: Typically, the things companies wish to measure are difficult to measure. For example, most companies struggle with how to clearly describe what constitutes customer value and therefore, measuring customer value becomes a very difficult task. The consequence is that companies stop trying and fall back on traditional metrics focusing on internal efficiency, product performance and quality as indirect measures of value. Instead, we recommend that companies hypothesize proxy metrics that are indicators of customer value, measure these over multiple releases and do correlation analysis between confirmed customer value delivery and the proxy metric with the intent of identifying metrics that have a strong correlation with customer value.

Seek to continuously shorten feedback cycles with customers: The ability to continuously evaluate improvements relies on accurate and frequent feedback from customers. In addition to being critical for validation of improvements, customer feedback is important as companies seek to minimize development efforts and investments in between proof points. The shorter feedback cycle, the faster teams learn, and the smaller the investment is if a feature turns out to not prove valuable. One of the key enablers to this is DevOps practices. We recommend companies to adopt DevOps capabilities for at least parts of their systems as it allows for the opportunity to start running A/B experiments to measure the impact and value of new features on a frequent basis.

Develop an experimentation infrastructure: The ability to run experiments provides companies with the foundation to learn about feature and system usage and about what adds value to customers. A/B testing is a powerful mechanism for identifying and evaluating value and it forms the basis for a hierarchical value model in which metrics at different levels contribute to an overall understanding of customer and business value. We recommend companies to develop an experimentation infrastructure and capabilities involving e.g., randomization algorithms, assignment methods, and the data processing mechanisms. To scale these practices, we recommend companies to have dedicated groups that build, manage, and improve the experimentation infrastructure so that it can be effectively employed by many teams.

Develop a hierarchical value model: Establishing a quantitative understanding of the use of the system is critical. Companies can either use historical data to understand usage of a certain feature or instrument the software to start collecting data revealing feature usage. To evaluate feature improvements, and to understand if the overall system is improving as desired, companies need a hierarchical value model. In such a model, there

needs to be a single, or at least very few, high-level metrics that translates into lower-level metrics and to which the lower-level metrics contribute. A hierarchical value model details the relationships between metrics and incorporates the tradeoff among lower-level metrics. With a hierarchical value model in place, companies can continuously monitor and evaluate value to ensure that development efforts and investments are allocated to functionality with proven customer value.

Continuously validate the hierarchical value model and evolve it over time: To avoid misalignment between teams and sub-optimization of efforts, the value model needs to be maintained over time. This involves having teams responsible for parts of the system and its related metrics, it involves having teams responsible for the overall alignment of the value model as it evolves, and it involves continuous introduction and evaluation of new metrics. Over time, evaluating and adjusting the high-level metric(s) and understanding causes and effects becomes easier. By running experiments and interpreting the results companies will not only learn what metrics work best for certain types of experiments but also learn how to develop and introduce new metrics into the value model.

6 Threats to validity

As the basis for our understanding of digital transformation and the role of data in the shift towards continuous practices, we reviewed contemporary literature on this topic. Based on this, we conducted multi-case study research in selected primary and secondary case companies in the embedded systems domain. To mitigate validity threats, and to address construct validity [Ma12], we started each workshop with sharing our view on digitalization and the impact digital transformation has on the ways in which companies work with data. By doing this, we established a common understanding, and we could focus the discussions using terminology that was familiar for everyone involved. With regards to external validity, our research contributions are related to what Walsham [Wa95] defines as "drawing of specific implications" and as a contribution of "rich insights".

7 Conclusions and future research

At the core of digitalization and digital transformation is the shift towards continuous value delivery to customers. For companies in the embedded systems domain, this shift implies that product sales and transactional business models are increasingly being complemented with service sales and recurring revenue streams. For companies in the embedded systems domain, this includes traditional service approaches where the physical product is offered as a service or where other aspects, such as maintenance of the product, are provided as a service [BO21]. In this transition, data practices are critical as they lay the basis for new data driven and digital offerings. In this paper, we explore the challenges

companies experience in the transition from traditional towards continuous data practices and the implications this shift has on their ways of working with data. In the paper, we identify the key challenges that companies in the embedded systems domain experience in the transition towards continuous data practices. Second, we derive four organizational anti-patterns that we see reduce the benefits of data practices in large software-intensive embedded systems companies. Third, we provide a set of recommendations to help companies evolve beyond their current state.

In future research, we aim to study how to better combine and make effective use of different data sources that companies have available. Our goal is to provide a holistic understanding of the opportunities that continuous data practices bring and how different organizational roles can benefit from these for decision-making purposes.

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Perception of Social Costs of Digitalization: Profiling Top Managers, Middle Managers, and Front-line Employees

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Abstract: Although information technology has become advanced in profiling users, we often offer this knowledge to marketing and forget that profiling is needed for information technology implementation itself. If digitalization is introduced in a firm, it may encounter internal resistance. Top managers, middle managers, and front-line employees may have different expectations with regard to digitalization initiatives in their firms. Having different visions of what digitalization is about may result in conflicts with regard to digital solutions selection and implementation and, consequently, lead to digitalization failure. In this paper, we look at differences in digitalization cost perception using a Discrete Choice Experiment. Based on our findings, we propose to approach firms by profiling top managers, middle managers, and front-line employees.

Keywords: Digitalization, Profiling, Discrete Choice Experiment, Social Costs, Software Solutions Perception

1 Introduction

Although information technology has become advanced in profiling users [ENS19], we often offer this knowledge to marketing and forget that profiling is needed for information technology implementation itself. Digitalization as an "emergence of technological platforms of information and communications technology (ICT) is determining significant and unprecedented changes in many aspects of our social and economic life" [CO02]. These different aspects of social life could be addressed using profiling techniques.

Witschel and colleagues [WDK19] argue that "because of path dependencies, lack of sensitivity and experience, high uncertainty and a "knowledge-doing-gap" most companies struggle to respond to digital disruption." One should add another aspect to this list - the social costs of digitalization [BO19, BS10]. Digitalization impacts the whole firm, including top management, middle management, and front-line employees. Yet, if digitalization is being introduced in a firm, it may encounter internal resistance. Top managers and middle managers are different in their decision styles which might lead to

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different outcomes [Nu90]. This is especially important for the digitalization initiative: having different visions of what digitalization is about may result in conflicts with regard to digital solutions selection and implementation. This paper answers a research question “What is the value of different social costs accompanying digitalization for top managers, middle managers, and front-line employees?”

2 Theoretical background

Digitalization is a “process of transforming the structure, processes, people skills and culture of the entire organization so it can use digital technologies to create and offer products, services and experiences that customers, employees and partners find valuable” [SAK16]. Consequently, social costs that a firm encounters incorporate not only the firm’s internal costs but also relational costs with the firm’s partners. While many researchers focus on direct technology costs during the implementation phase [BL02, IEG97, IL00], it is the social issues that may lead to the failure of organizational transformation [BS10, IL00, ACF00]. In this short paper, we exploratively investigate the differences in perception of social costs of digitalization by the top and middle managers and front-line employees in order to explain reasons for internal struggles and failures of digitalization.

Social costs are costs of perception, i.e., they are by definition of a subjective nature. For instance, even though the price of a product is the same, the associated expected utility will differ for each individual [Mc74]. Moreover, individuals have their own demands, whereby different characteristics of the product may have a different fit [La91]. These different characteristics may impact the willingness to pay, i.e., to bear costs [MW14, MPM19]. Yet, the “payment” can be not only monetary but also a sacrifice of efficacy [HDD14] or efficiency [BO19]. In our study, we want to explore the question of the perception of social costs among managers and front-line employees of a firm. We are interested in the perceived differences between top managers, middle managers, and users without managerial experience. The goal of the study is to understand the differences in willingness to pay (or in our event, willingness to trade efficiency) for different social costs accompanying digitalization projects.

Based on research conducted by Bunduchi and Smart [BS10] and Bogodistov and Ostern [BO19], we decided to focus on the implementation phase of a digitalization project and the three types of its indirect costs: (1) organizational costs, i.e., costs related to necessary changes in corporate practices, structures, and work processes plus temporary declines in productivity; (2) human costs that are attributable to individuals and include training costs or additional time requirements; (3) relational costs, i.e., costs related to the lack of trust that arises from business partners within a supply network [BO19, BS10, ACF00]. Revealing the preferences of each of the investigated groups with regard to the social costs of digitalization can be used as the input for profiling digitalization users.

At the same time, we understand that in order to address the issue systemically and to offer a solution for software developers one needs to introduce structure and, if possible, a categorization of different digitalization users. To do so, one needs to reveal the preferences with regard to each aspect of the social costs of digitalization. In order to achieve this result, we conducted a discrete choice experiment. This method allows us to understand differences in perception of different aspects of digitalization as well as estimate willingness to pay for these aspects. As it would be biasing to ask about the value of different digitalization-related costs in EUR – for small firms 1,000 EUR would be a big sum while for large corporations even 100,000 might be a relatively small number – we used *efficiency growth* as an equivalent of money. Consequently, we were able to calculate willingness to "trade" different social costs of digitalization for efficiency [HDD14]. As each firm has its own value reflected in efficiency, this is a good equivalent for the willingness to pay [BO19].

3 Methodology

3.1 Experimental design

In order to address our research question, we applied a discrete choice experiment. A DCE contains two main types of variables: attributes and levels – the independent variables, and the variable capturing a decision, i.e., the dependent variable. An attribute stands for the name of the category of product-related aspects, e.g., "organizational costs of digitalization" or "relational costs of digitalization". Each attribute can have several levels of a categorical (e.g., "additional learning costs"/ "salary adjustments") or can be of a scalable nature (e.g. "10%, 11%, 12%, 13%"). The decision variable is dichotomous" (project rejected or accepted). We used Qualtrics© in combination with the Conjoint Survey Design Tool by Hainemueller and colleagues [HHY14].

In our DCE, we asked each participant to choose between two digitalization solutions. Each solution had a short description of the associated social costs. Each project referred to four attributes related to organizational, human, and relational costs as well as expected efficiency gains brought through these solutions. Tab. 1 shows the different levels for each attribute of the proposed digitalization solutions.

In order to avoid a possible ordering bias, we randomized the appearance of the attributes and levels. All attribute positions, as well as levels, were randomized (Fig. 1). We adopted the initial attributes and their respective levels from previous research [4, 5].

The willingness to trade efficiency is calculated by the formula [BO19, HDD14]:

$$Willingness\ to\ trade\ efficiency = \frac{B\ of\ focal\ indirect\ cost}{B\ of\ efficiency\ gain * (-1)} \qquad \text{(Equation 1)}$$

Put differently, willingness to trade indicates how much of the level of the attribute “Efficiency gain” the participant would be willing to give up (or receive) in order to start preferring the focal attribute.

Level / Attribute	**0**	**1**	**2**	**3**
Organizational Costs	Temporal deceleration of business processes[1]	Excessive usage of company resources	Additional costs for adjustments of business processes	Additional costs for adjustments of the company structure
HR-related Costs	Increased expenditure of employees’ time	Additional learning costs of employees	Salary adjustment[2]	Additional HR costs
Relational costs	Emerging ‘ill feelings’ by business partners	Tensions by business partners due to incompatibilities	Triggering internal discussions by business partners	-
Efficiency gain	10%	11%	12%	13%

Tab. 1: Attributes and levels of a digitalization project, translated from German

3.2 Data Collection and Sample

The population consists of persons who are associated with the implementation of digitalization projects. In particular, the study addressed individuals using digital solutions. We shared the link to the online experiment in groups for digitalization on social networking platforms such as LinkedIn. Further, we distributed the link via email to personal and professional contacts. The study was conducted in German and English language, involving professionals from European countries.

In our analyses, we controlled for the role and position within the company, age, work experience, and country of origin. Overall, we managed to collect 156 answers, whereby 78 participants were female and 78 were male. The average age of participants was 36.76 years (*SD* = 8.81). We had an interesting representation of functions: 36 participants were managers, followed by 40 participants active in finance/controlling, 18 in Back-Office,

[1] In contrast to the study by Bogodistov and Ostern [4] we stressed the *temporal* nature of business process deceleration.

[2] In Austria and Germany salary adjustment means salary increase since a decrease is legally prohibited.

and 16 from administration or IT. Front-office was represented by 8 participants, 4 were from supply chain management, 2 were from product development, and 32 indicated “other”. With regard to the position in their firm and managerial responsibilities, 74 participants indicated “Employee without managerial responsibilities”, followed by 36 “Head of Department”, and 32 “Middle Management”. A number of 12 participants were C-level managers, while 2 participants indicated “Private Entrepreneur” and “Management Support” (German “Stabsstelle”). With regard to their experience, most participants (78) had 6 to 15 years of experience, 42 participants had 1-5 years of experience, 32 participants had more than 15 years of work experience, and 2 participants had worked for less than one year.

As each participant was asked to make ten decisions during the experiment and as each decision contained implicitly two decisions (for one option and against the other option, Fig. 1), we came up with 1,618 cases to analyze (due to a few missing observations).

	Project 1	**Project 2**
Human Costs (in relation to the digitization project)	Additional learning costs of employees (e.g., resource expenditure for training courses)	Changes in salary structure (e.g., due to increased qualification and capabilities of employees)
Organizational Costs (organizing the project implementation)	Excessive usage of company resources (e.g., IT-resources because of newly emerging processes)	Excessive usage of company resources (e.g., IT-resources because of newly emerging processes)
Efficiency Gain (process optimization)	10%	13%
Relational Costs (business partners' costs due to digitization)	Tensions by business partners due to incompatibilities (e.g., the new IT system produces data in a new format)	Triggering internal discussions by business partners (e.g., controversial discourse about similar projects)
Which of the digitalization projects do you prefer?	○	○

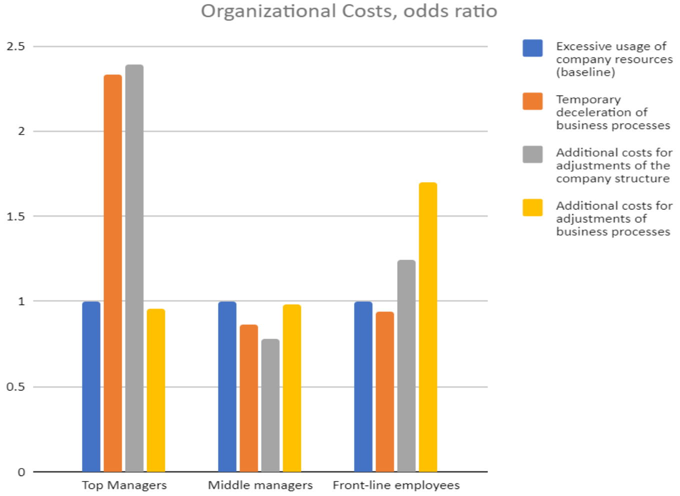
Fig. 1. Example of a Selection Decision, translated from German

4 Results

4.1. Calculation of the perception of the social costs

We analyzed our data using logistic regression as our dependent variable was coded as 0 (project rejected) or 1 (project accepted). We split the file based on the variable "managerial experience". We coded this variable as "top managers" for C-level managers, "middle management" for middle managers and department chiefs, and "no managerial functions" for the rest of the participants. Management support was coded as "middle management", while the private entrepreneur became a "top manager" as being responsible for strategic decision-making in his/her firm. Afterwards, we ran a *t*-test to indicate group moderation effects. We found that there are significant effects within groups and that in some perceptions of costs, results show statistically significant differences between the groups (see Tab. 2, Tab. 3, Tab. 4 in Appendix).

Based on the data, we can depict the profiles of an average top manager, a middle manager, and a front-line employee. As we can see, with regard to organizational and HR-related costs, the perceived value of social costs related to digitalization allows us to create profiles for each target group. For instance, instead of excessive usage of the company's resources top managers would two times more likely prefer temporal deceleration of business processes or would be willing to adjust the company's structure. Front-line employees are also not willing to have excessive usage of resources if compared to adjustments of business processes and their firm's structure. Instead, they would strongly prefer the adjustment of business processes (about 1.7 times more likely option). Middle managers would not trade the excessive usage of resources against adjustment of business processes. Yet, in contrast to top managers and front-line employees, they would rather prefer to excessively use the company's resources than adjust the company's structure (Fig. 2). Knowing the preferences might help, first, frame the digitalization project in an acceptable for the target group way and, second, help software producers address the preferences in the long-term perspective when developing new solutions.



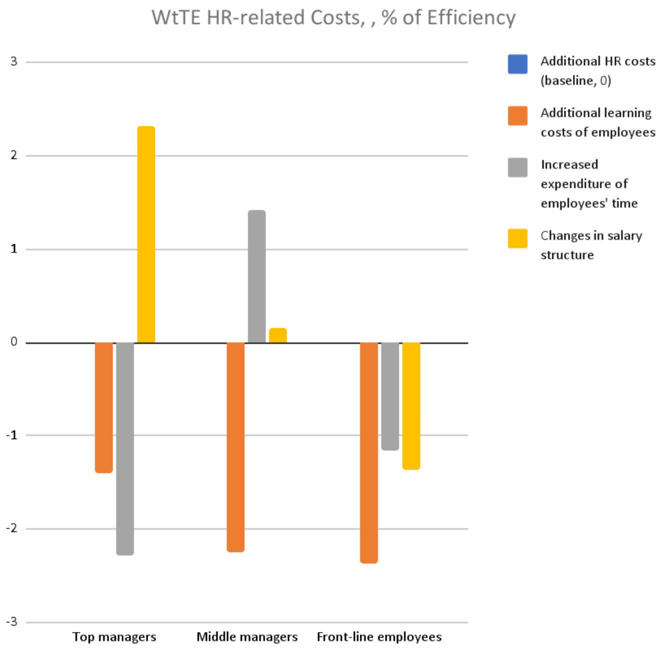
Note: The baseline *Exp(B)*is equal to 1, i.e. the participant is set to be indifferent. The other values are either higher than 1, i.e. the participant prefers the focal attribute over the baseline, or lower than 1, i.e. the participant prefers the baseline over the focal attribute.

Fig. 2. Preferences with regard to organizational costs.

4.2. Profiling based on the willingness to trade social costs against efficiency gains.

After discovering the preferences of different groups of participants with regard to different aspects of social costs of digitalization, we calculated the willingness to trade each of the levels against efficiency gain, i.e. our equivalent of “money”. The results are shown in Tab. 5

The perception of efficiency gains allows us to develop the following profiles of managers of different levels as well as of front-line employees with regard to the costs of digitalization costs perception (Equation 1, Fig. 3). Negative values in other attributes indicate that a person needs to be offered a higher efficiency gain in order to accept the social cost. A positive value means that the person is even willing to sacrifice efficiency in order to receive this social cost. All values are comparative, e.g., if a top manager sees that digitalization is accompanied by additional HR costs (baseline) and changes in salary structure, she would accept the latter until efficiency gain does not exceed 3%.



Note: As a baseline value, additional HR costs are set to 0.

Fig. 3. Profiling based on the perceived value of HR-related costs.

5 Discussion

Our analysis made it possible to, first, understand that there are differences in the perception of organizational costs related to digitalization. Our findings elucidate that digitalization plays a different role at different levels of a firm. For instance, we observe that top managers are ready to (temporarily) accept a slow-down of their business processes and their firm's restructuring, but tend to avoid process restructuring and excessive usage of their firm's resources. Yet, the opposite is the case for middle managers. As top managers have to deal with a more abstract level of analysis (e.g. long-term planning), have a better overview of the industry, and possess more information about the internal situation across different divisions and departments of their firm, they may perceive the digitalization as an investment in their capability accepting changes in the hierarchy over changes in business processes [GJ15].

Knowing the existing preferences can help firms explain conflicts that appear within a firm if it starts a digitalization initiative. Moreover, it is not clear, why top managers perceive HR-related costs as less preferable than salary adjustment. Interestingly, the average efficiency gain top managers would be willing to give up for salary adjustments is about 3 per cent. We may assume that they “convert” efficiency gain into money and calculate an adjusted salaries equivalent. A further investigation with the attribute “Price in EUR” in a combination with information about the salaries in a firm could shed light on the reason for the observed result.

Second, if consultants and external software providers offer a digitalization solution, they have to bear in mind that they need to use a different “language” in their communication at different organizational levels [Mo14]. For instance, efficiency gain as a contribution of digitalization is a good argument for front-line employees, but not as good for top managers. Our research might help external providers of software solutions for digitalization to establish better communication and avoid possible conflicts.

Third, any firm should profit from digitalization - a way to re-organize a firm's roles, social life, and business processes [RP20]. Even though the benefits might be clear for top management, they have to communicate them correctly to a firm’s middle management and its front-line employees. As our research shows that they have a different understanding of social costs, they need to “frame” digitalization accordingly. Focusing on efficiency gains for front-line employees and the value of employees' work time for middle managers might help them foster the implementation of digital technologies in their firms.

Of course, this research makes only a first step in the direction of profiling different levels within a firm, future steps are needed. For instance, researchers might be interested in investigating profiles of different departments or even the firms’ profiles. We can imagine that service-oriented firms might have a different vision of the social costs of digitalization as compared to manufacturing firms and that IT departments (i.e., developers of digitalization solutions) may think differently than sales departments (i.e., users of digitalization solutions). We see great potential in research in this field and stress the necessity of such research. Indeed, the new digital economy requires compromises. Yet, many of these compromises are a matter of perception. If we ignore their perceptive nature, we may end up in a set of conflicts that hinder digitalization and diminish the role of digital technology in firms all over the world.

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Appendix

DV: Decision	Top managers				Middle managers				Difference	
	B	*S.E.*	*p*	*Exp (B)*	*B*	*S.E.*	*p*	*Exp (B)*	*t*	*p*
Organizational costs Baseline: “Excessive usage of company resources”										
Temporary deceleration of business processes	.847	.637	.183	2.334	-.147	.241	.541	.863	1.512	.131
Costs for adjustments of the company structure	.871	.667	.191	2.390	-.251	.243	.302	.770	1.679	.094
Costs for adjustments of business processes	-.040	.629	.949	.961	-.018	.234	.939	.982	.035	.972
Human costs Baseline: “Additional HR costs”										
Additional learning costs of employees	.264	.599	.659	1.302	.801	.236	.001	2.229	.830	.402
Increased expenditure of employees’ time	.429	.657	.515	1.534	-.507	.233	.030	.602	1.452	.147
Salary adjustments	-.436	.607	.472	.646	-.055	.229	.810	.946	.609	.543
Relational costs Baseline: “Triggering internal discussions by business partners”										
Tensions by business partners due to incompatibilities	-.332	.540	.539	.717	-.021	.201	.919	.980	.566	.572

Emerging 'ill feelings' by business partners	-1.328	.563	.018	.265	-.244	.207	.237	.783	1.910	.057
Efficiency	.188	.195	.336	1.207	.356	.076	<.001	1.428	.812	.417
Constant	-3.163	4.294	.461	.042	-4.622	1.141	.001	.010	.370	.712

Tab. 2: Top managers' vs middle managers' costs perception

DV: Decision	Top managers				Front-line employees				Difference	
	B	*S.E.*	*p*	*Exp (B)*	*B*	*S.E.*	*p*	*Exp (B)*	*t*	*p*
	Organizational costs Baseline: "Excessive usage of company resources"									
Temporary deceleration of business processes	.847	.637	.183	2.334	-.063	.237	.789	.939	1.359	.174
Costs for adjustments of the company structure	.871	.667	.191	2.390	.220	.221	.319	1.246	1.025	.306
Costs for adjustments of business processes	-.040	.629	.949	.961	.530	.232	.022	1.699	.868	.386
	Human costs Baseline: "Additional HR costs"									
Additional learning costs of employees	.264	.599	.659	1.302	1.060	.229	.001	2.888	1.233	.218
Increased expenditure of employees' time	.429	.657	.515	1.534	.517	.231	.025	1.677	.135	.892
Salary adjustments	-.436	.607	.472	.646	.612	.229	.007	1.844	1.621	.105

	Relational costs Baseline: "Triggering internal discussions by business partners"									
Tensions by business partners due to incompatibilities	-.332	.540	.539	.717	-0,425	0,197	.031	.653	.167	.868
Emerging 'ill feelings' by business partners	-1.328	.563	.018	.265	-0,803	0,200	.001	.448	.922	.357
Efficiency	.188	.195	.336	1.207	0,448	0,074	.001	1.565	1.243	.214
Constant	-3.163	4.294	.461	.042	-4.622	1.141	.001	.004	.660	.510

Tab. 3: Top managers' vs front-line employees' costs perception

DV: Decision	Middle managers				Front-line employees				Difference	
	B	*S.E.*	*p*	*Exp (B)*	*B*	*S.E.*	*p*	*Exp (B)*	*t*	*p*
	Organizational costs Baseline: "Excessive usage of company resources"									
Temporary deceleration of business processes	-.147	.241	.541	.863	-.063	.237	.789	.939	.248	.805
Costs for adjustments of the company structure	-.251	.243	.302	.770	.220	.221	.319	1.246	1.439	.150
Costs for adjustments of business processes	-.018	.234	.939	.982	.530	.232	.022	1.699	1.664	.096
	Human costs Baseline: "Additional HR costs"									

Additional learning costs of employees	.801	.236	.001	2.229	1.060	.229	.001	2.888	.788	.431
Increased expenditure of employees' time	-.507	.233	.030	.602	.517	.231	.025	1.677	3.119	.002
Salary adjustments	-.055	.229	.810	.946	.612	.229	.007	1.844	2.058	.040
Relational costs Baseline: "Triggering internal discussions by business partners"										
Tensions by business partners due to incompatibilities	-.021	.201	.919	.980	-.425	.197	.031	.653	1.437	.151
Emerging 'ill feelings' by business partners	-.244	.207	.237	.783	-.803	.200	.001	.448	1.945	.052
Efficiency	.356	.076	<.001	1.428	.448	.074	.001	1.565	.863	.388
Constant	-4.622	1.141	.001	.010	-4.622	1.141	.001	.004	.510	.610

Tab. 4: Top managers' vs middle managers' costs perception

DV: Decision	Willingness to trade social costs against efficiency, %		
	Top managers†	Middle managers	Front-line employees
Organizational costs *Baseline*: "Temporary deceleration of business processes"‡			
Excessive usage of company resources	-4.509	.412	.141
Costs for adjustments of business processes	-4.635	.706	-.491
Costs for adjustments of the company structure	.212	.050	-1.184
Human costs *Baseline*: "Additional HR costs"‡			
Additional learning costs of employees	-1.406	-2.249	-2.367
Increased expenditure of employees' time	-2.276	1.423	-1.154
Salary adjustments	2.321	.154	-1.367
Relational costs *Baseline*: "Triggering internal discussions by business partners"‡			
Emerging 'ill feelings' by business partners	1.768	.058	.950
Tensions by business partners due to incompatibilities	7.063	.686	1.793

Note: † − a negative value indicates that one has to pay the participant to make him prefer the indicated option; a positive value indicates that the participant would be willing to pay to have the preferred option. Put differently, even if we say that the accompanied efficiency gain is ≤ to the indicated value, she will prefer the indicated option.

‡ - the baseline (i.e., comparative value). Put differently, if a number is positive, the participant is ready to give up efficiency in order to have the focal cost instead of the baseline cost. A negative value indicates that one has to offer the indicated efficiency gain in order to make the participant prefer this option.

Tab. 5: Willingness to trade different social costs accompanying digitalization against efficiency gain.

How does the role of a Product Owner relate to the role of a Software Product Manager?

Timo Toikkanen[1], Sami Hyrynsalmi[2], and Maria Paasivaara[3]

Abstract: In the Scrum Guide, the Product Owner (PO) is defined as being accountable for maximizing the value of the product they are responsible for. Thus, a Product Owner shares many responsibilities with a Software Product Manager (SPM), who is defined as a role governing the creation of the highest possible value to the business from the product. Despite the vast popularity of Scrum and other software development methods based on it, the role of a Product Owner has not received much academic research yet. This study contributes to the literature by assessing the similarities and differences between Product Owners and Software Product Managers using exploratory semi-structured interviews with 16 Agile software professionals. The study shows that the concept of product value is not always evident to Product Owners responsible for maximizing it. In addition, we identify five Product Owner Scenarios. Depending on the Product Owner Scenario, Product Owners' responsibilities overlap to a varying degree with Software Product Manager's responsibilities defined in the ISPMA SPM framework. Overall, further work is required to clarify the role and responsibilities of a Product Owner in various types of real-life organisations.

Keywords: Product Owner, Software product Management, Product Owner Scenario

1 Motivation

Customers invest in software for a reason. There needs to be a benefit that the customer will receive from the capabilities provided by the software. There are countless opportunities to leverage software for value creation. Assuming a typical, modern software development setting, the responsibility for maximizing the value falls on the shoulders of a nominated *Product Owner* (PO) [SS20]. Considering the ubiquity of software, the decisions made by POs have an impact on modern life in many ways. The PO is also a probable key contributor to the success of many contemporary businesses.

The role of a PO originates from Scrum [Ke19]. The Scrum Guide [SS20] describes the PO as a single person, not a committee, responsible for maximizing the product's value resulting from the Scrum team's work. A blog post by ScrumAlliance explains that the PO is responsible for tactical and strategic product decisions and is typically closely involved with the business side of the organization. At the same time, POs are given specific responsibilities to the Scrum team [SS20], which would typically be considered a part of the development organization. The blog post portrays the PO as a connector between

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product strategy and the development team. The attributes of great POs include being empowered, knowledgeable, empathetic, available, and decisive. The role is unique and challenging.

However, despite the substantial popularity of agile software development methods and Scrum in the scientific community, there is surprisingly little research on POs and product ownership. For instance, as of the end of January 2023, Scopus has indexed only 41 and 58 articles where "*product owner**" is a part of the title or the keywords (either defined by the authors or the indexing database), respectively. For comparison, a Scopus search with the term "*scrum*" returned 1,220 and 1,978 articles with respective limitations. The number of studies explicitly addressing POs is remarkably low. For example, in a recent bibliographical study conducted in 2021, the authors found merely 142 studies addressing software or digital product management [HSS21].

Nevertheless, the PO is given the strategic responsibility for maximizing the product's value [SS20]. In addition, the PO has specific operational responsibilities to the Scrum team, mainly related to managing the product backlog [SS20]. Combining the two might seem like a lot for one person. While POs are accountable for maximizing the value of the product, Ebert [Eb07] defines software product management (SPM) as '*the discipline and role that governs a product from its inception to market/customer delivery to generate the biggest possible value to the business*.' The ISPMA SPM framework [Ki22] provides a structured view of the elements of software product management. The above suggests a potential overlap and conflict between the roles of a PO and a software product manager.

Thus, this study focuses on exploring the potential overlap between the roles and responsibilities of a PO and the elements of software product management, as defined in [Ki22], via two research questions:

RQ1 How do Product Owners understand value in the context of their products?
RQ2 How does the role of a software product manager, as defined by the ISPMA SPM framework, relate to that of a Product Owner in Scrum?

To answer the presented questions, this study adopts a qualitative research approach with semistructured interviews. 16 experienced POs and Agile practitioners were interviewed, yielding 901 minutes of recorded interviews. For the data analysis, the Gioia method [GCH13] was applied. The remainder of the study is structured as follows. Section 2 covers the previous work on the roles of a PO and a software product manager. Section 3 discusses the research approach, and Section 4 the results. The implications of this work, as well as limitations and conclusions, are discussed in Section 5.

2 Background

Ken Schwaber and Jeff Sutherland introduced Scrum at an ACM research conference in 1995, implying that its history predates the Agile manifesto. Scrum has evolved significantly between 1995 and the 2020 Scrum Guide [Ve20], which as of 2022, can be considered the authoritative definition by the two co-founders. The Scrum Guide [SS20] introduces Scrum as a '*lightweight framework that helps people, teams and organizations generate value through adaptive solutions for complex problems*' and states that it is founded on empiricism and lean thinking. Scrum intends to be applicable also outside of software development.

According to the Scrum Guide [SS20], a Scrum team comprises a Scrum Master, developers, and a PO. The Scrum Guide [SS20] describes Scrum teams as cross-functional and selforganizing groups of individuals collaborating to deliver a product. According to the Scrum Guide [SS20], the size of a Scrum team should be less than ten persons, while Verheyen [Ve21] suggests that teams have the highest cohesion when the number of people is between five and seven. Each Scrum team has one and only one PO accountable for maximizing the product's value [SS20]. However, the provided framework does not give any definition or measure for the value of the product. The PO may represent the needs of several internal and external stakeholders. The PO defines a product goal that serves as a target for the team. Verheyen [Ve20] explains that the product goal should be derived from a longer-term product vision, although the Scrum Guide [SS20] does not mention the product vision. Product goal-related business expectations and ideas, in other words, requirements expressed by the PO, are continuously captured as items in a product backlog. The PO is responsible for creating backlog items, ordering them, and communicating the product backlog to the team. The PO has authority and responsibility over the product backlog. The PO is responsible for ensuring that attendees are prepared to discuss the highest priority backlog items and their relationship with the product goal. The PO also proposes how the sprint could increase the product's value. Developers discuss with the PO to define a sprint goal and select the backlog items to be implemented in the sprint. The selected backlog items may be broken down into tasks [Su10].

Kittlaus [Ki12] discusses the potential conflicts between the roles of a PO and a Software Product Manager. The Scrum PO is a member of the development team, whereas the ISPMA SPM framework[1] [KF17, Ki22] represents development as one of the seven functional areas of Software Product Management. According to Kittlaus [Ki22], assigning the two roles to the same person is problematic because the operational responsibilities of a PO need to leave more time for the strategic responsibilities of a Software Product Manager. Kittlaus [Ki12] proposes that, in larger organizations, the two roles should be separate but dependent. In small organizations, the two roles may be

[1] International Software Product Management Association (ISPMA) is an organization fostering software product management excellence. ISPMA has published a reference framework for software product management, see https://ispma.org/bok/

assigned to the same person, taking care of the responsibilities of a PO as well as all the applicable parts of the ISPMA SPM framework [Ki12].

In academic research, Sverrisdottir et al. [SIJ14] interviewed five POs and found that the roles and responsibilities varied significantly between organizations. Based on a somewhat limited sample of five POs, Sverrisdottir et al. [SIJ14] concluded that the role and the responsibilities are seldom in perfect conformance with the Scrum Guide [SS20]. Bass et al. [Ba18] noted that few studies report how POs perform their role and what the related activities are. Bass et al. [Ba18] interviewed 55 POs and provided a grouping of the activities identified. However, detailed descriptions of the activities were left for further work. According to Bass et al. [Ba18], their research shows that POs perform a wide range of challenging activities requiring authority to influence.

Unger-Windeler et al. [UWKS19] conducted a mapping study to identify, analyze, and categorize existing research literature on the role of a PO. They found a need for additional, profound insights into the relationship between the roles of a PO and a Product Manager. One more takeaway from Unger-Windeler et al. [UWKS19] is that '*No PO role is like the other*'. Pursuing a similar line of thought, a LinkedIn post by Rafael Calovi[1] challenges the reader to find three persons who agree on the best definition of the role of a PO.

3 Research Method

This study is exploratory and uses a qualitative approach. We chose a semi-structured interview method to collect data and uncover unexpected perspectives. However, it is worth noting that open-ended questions may produce data that can be challenging to code and analyse [KP02]. The interview instrument consisted of eight parts, specifically formulated to address the research questions of the study. The first three parts introduced the study, interviewee, and the organization represented by the interviewee. The following section assessed conformance to the Scrum Guide [SS20], while the subsequent parts examined the meaning of product value and the potential overlap between the roles of a PO and a Product Manager. Lastly, the interview concluded with two straightforward questions that asked the interviewee to identify the essential skills required for the role and any challenges they may face.

The interviews were conducted during the summer and autumn of 2022. All interviews were conducted one-on-one using Microsoft Teams video conferencing. Participants could choose to have the interview in English or Finnish. The objective of the interviews was to yield a sample that would bring out new insights into the role of a PO. The selection criteria

[1] Calovi, R., 2021. Safe is too prescriptive. [Online]. Available: https://www.linkedin.com/pulse/safe-tooprescriptive-rafael-calovi/

for the participants were defined accordingly. Initially, the premise was that the participants of the study would be currently or previously working as POs. Candidates with at least five years of experience working in the software industry were preferred in the selection process. The intention was to select candidates representing different types of software development organizations, each with its own development processes. Interviewees from organizations that did not use Scrum were seen to add variety to the sample.

#	Org.	Len.	Summary
1	A	56′	Nearly 30 years of experience in the software industry, two years in the role of a PO
2	A	61′	The youngest professional among the participants with one year of experience in the software industry, recently taken over the role of a PO
3	A	80′	Approximately 20 years of professional experience in the software industry, four years in the role of a PO
4	A	47′	Approximately 20 years of professional experience, three to four years in the role of a PO
5	B	60′	More than 10 years of experience in the software industry, two years in the role of a PO
6	C	65′	Assumed the role of a PO during a period of five and half years
7	D	56′	Experienced Agile practitioner, never worked as a PO. Nevertheless, capable of explaining how the role and the related responsibilities were defined in the organization
8	B	52′	Various roles in the software industry, three years in the role of a PO
9	E	54′	Background in both industry and academia, three and half years of experience in the role of a PO
10	F	52′	Several years of experience working in the PO and Product Manager type of positions
11	G	43′	PO on a mission to develop business analytics for the organization
12	H	51′	Background working as an Agile Consultant and a PO, currently working as a consultant specializing in due diligence
13	I	44′	Long background in the software development industry, currently working as a PO
14	J	75′	Various positions in information technology including PO responsibilities
15	D	45′	PO based in Sweden
16	K	59′	Various PO and Product Management positions

Tab. 2: The interviewees with their respective organizations and the length of the interview records in minutes

The interviewed POs were initially recruited from personal networks. The sample was expanded throughout the interview process by asking interviewees to refer to other POs whom they knew. This kind of sampling technique is known as snowball sampling [Go61] or chain referral sampling. However, because people are likely to know and provide referrals to other people with similar traits, the reliance on personal networks may introduce sampling bias. The resulting sample is non-statistical and not necessarily representative of the whole population of professionals identifying themselves as POs. Conceptually, with a non-statistical sample, findings cannot be generalized back to the population. Therefore, any of the results must be considered exploratory and not conclusive, in line with its objectives.

The plan was to continue the interview and participant recruitment process until patterns or repetitions arose. A total of 16 experts were interviewed for the study (see Table 1). All except for one of the interviewees were currently or previously working as POs. Nevertheless, this person was capable of explaining how the role and its related responsibilities were defined in the organization. All but one of the interviewees met the

criteria for having at least five years of experience in the software industry. The sample includes participants representing smaller companies as well as some of the largest technology companies in the world. While most of the participants worked in the software product business, some worked in the software service business. It's worth noting that the sample includes participants from organizations using the job title 'Product Manager' instead of 'Product Owner'.

The organizations represented by the interviewees are briefly described in Table 2, along with a brief description of the industry in which they operate. Some of the organizations are part of large, multinational companies. The roles and responsibilities of a PO may vary from one part of the organization to another, implying that the experiences of the respondents are not necessarily generalizable to the entire organization. To maintain anonymity, no further information on the respondents or the organizations is not disclosed.

#	Company Sector	Identified Product Owner Scenario
A	Communication industry	SAFe-like Organisation
B	Software service and product company	Compact Organisation
C	Medical technology	Separate Product Management
D	Insurance sector, respondents from Finland and Sweden	Internal Customer
E	Software products for the medical sector	SAFe-like Organisation
F	Online advertisement	Internet Company
G	Forest industry	Internal Customer
H	Management consultancy	-
I	Medical technology	Separate Product Management
J	Online retail	Internet Company
K	Prominent technology company	Internet Company

Tab. 2: Summary of the Organisations

The recorded audio was transcribed by a professional transcription company using naturalized transcription, also referred to as 'intelligent verbatim' transcription, which aims to follow the conventions of written language [Bu00], ignoring the characteristics of spoken languages, such as repetition, filled pauses, and grammatical errors. As a result, 901 minutes of recorded audio were transcribed to about 100,000 words and 137 pages of text. The transcribed text was anonymized to ensure that the respondents or their employers could not be identified. QSR International's NVivo software was used as the tool for conducting qualitative data analysis. The coding of the interview data was guided by the Gioia method [GCH13], which is a widely accepted approach for qualitative data analysis. The method allows for inductive concept creation while maintaining '*qualitative rigour*' [GCH13]. The analysis process was iterative in nature. Along the process, concepts emerge from the data, and the process results in a three-layer abstraction hierarchy. While reading the interview transcriptions, codes for first-order categories were developed to mark parts of the text that were interpreted to convey a common message. First-order categories were grouped into more abstract second-order themes. Second-order themes were mapped to even more abstract codes referred to as overarching dimensions.

4 Results

Product Owner Scenarios

The roles and responsibilities of Product Owners can vary depending on the organizational structure to which they belong. Unger-Windeler et al. [UWKS19] concluded their mapping study as follows: ‘We hypothesize that the description of the Product Owners environment – especially in terms of organizational structure and the collaboration with traditional management roles – will make a difference in the description of this role.’ The results of this study support their hypothesis, as five distinct Product Owner Scenarios emerged from the interview data and analysis. These scenarios are primarily characterized by organizational structure and business model. Table 2[1] shows the mapping between organizations and their respective Product Owner Scenarios. The five identified Product Owner Scenarios are:

Internal Customer. Product Owners are typically members of software development teams responsible for creating software, such as business analytics, for internal use within an organization. In the Internal Customer scenario, the PO’s role is primarily focused on meeting the internal customer’s needs and requirements for the software. This scenario generally limits the commercial aspects of the role. However, the PO may also be involved in tasks such as internal invoicing, product marketing within the organization, and potentially even sourcing.

Compact Organisation. In the Compact Organisation scenario, Product Owners are often perceived as versatile ’jack-of-all-trades’ individuals who assume many of the responsibilities traditionally associated with software product management. While some aspects of product strategy may be handled by higher-level personnel within the company, several respondents representing Compact Organisations noted that Product Owners still manage a heavy workload.

Separate Product Management. In the Separate Product Management scenario, the Product Owner is a member of a development team who interfaces with a separate product management function, which is typically located outside of the development organization. In this scenario, the PO is responsible for product planning related to the software component of the product.

SAFe-like Organisation. SAFe-like Organisations can be considered a special case of the Separate Product Management scenario. In the interviews, the POs representing SAFelike Organisations were generally technically oriented, with a focus on requirements engineering. One distinguishing characteristic of these organizations is that the longer-term product roadmap is controlled by the product management function rather than the PO. While the respondents affiliated with this scenario noted that their organizations did not claim full compliance with the SAFe framework, they were clearly influenced by it. As such, the name ’SAFe-like’ was used to describe this scenario.

[1] Respondent 12 shared experiences from various organizations instead of focusing on Organisation H. Thus, Organisation H is not explicitly dealt with in this study and is not assigned to any Product Owner Scenario.

Internet Company. In the Internet Company scenario, the organizations conduct most of their business and interact with customers online, and some may use the SaaS business model. In this scenario, the interviewees representing the organization were referred to as product managers rather than Product Owners. Unlike in the Separate Product Management and SAFe-like Organisation scenarios, the product managers were members of development teams responsible for specific product functionalities. The development teams worked relatively independently of each other, but coordination between product managers from different teams was still required. Each team and product manager had specific contributions to the organization's business objectives, and the development teams had autonomy in defining their own ways of working.

RQ1: Value in the context of PO's products

The study aimed to challenge the respondents' understanding of the meaning of value. Respondent 7, representing the Internal Customer scenario, noted that since the purpose of the product was to automate a process, the product would not provide user value to any individual. Instead, the product would provide business value to the organization and be measured in terms of cost savings rather than revenue generation. In contrast, the POs in the Compact Organisation scenario focused on the economic success of the product from the vendor's perspective. They tracked sales revenue and product development costs, indicating that they took responsibility for the profitability of the product.

> 'Since I come from a sales background, the revenue brought in is what matters to me. Are customers willing to pay for the product, how is it priced, and is the business around the product profitable... And, of course, I have been contemplating the value for the customers.
> — Respondent 8 representing a Compact Organisation

Respondents 6 and 13, representing the Separate Product Management scenario, associated user value with the economic success of the product. Respondent 6 explained that the product needs to be user-friendly to build lasting relationships with customers, highlighting the importance of user value. Overall, the interviewed POs primarily approached product value from the perspective of the user. The cross-tabulation of the data revealed that user-centeredness was particularly prevalent in SAFe-like organizations. Notably, the POs in these organizations did not refer to any monetary indicators of the product value.

Two of the interviewees associated technical debt with product value. Technical debt can manifest itself as quality issues, delayed deliveries, and increased costs, indirectly affecting customers and users. Interviewees suggested that when ordering the product

backlog, the POs should consider the need for refactoring. The organizations in the Internet Company scenario stood out from the rest in quantifying product value. The decision-making of the POs in these organizations was guided by product metrics and objectives. Through product analytics, they appeared capable of establishing a strong link between user value and the financial performance of the product.

To conclude, the results highlight the context-dependent nature of value. All interviewees presented user-centered viewpoints, reflecting the Scrum Guide [SS20] and the principles of Agile that emphasize customer satisfaction. In the Internal Customer scenario, the business case of the product was based on cost saving rather than revenue generation. The POs in the SAFe-like Organisation scenario did not refer to any financial indicators of the product value. On the other end of the spectrum, the most business-oriented POs were observed in the Compact Organisation scenario and in the Internet Company scenario. The organizations in the Internet Company scenario were advanced in using quantifiable data to measure product value and POs' success in maximizing it.

RQ2: How does the Product Owner role relate to the role of a Product Manager?
RQ2 outlines the intersection between the role of a PO and the role of a Product Manager as defined by the ISPMA SPM framework. The interview questions and the coding of the data for RQ2 draw inspiration from the ISPMA SPM framework. According to Kittlaus [Ki22], the framework provides a holistic view of software product management activities.

When comparing the accountabilities of a PO defined in the Scrum Guide [SS20] to the range of activities included in the ISPMA SPM framework, the latter is remarkably wider. The PO responsibilities defined in the Scrum Guide [SS20] are mainly related to development, which is only one of the seven areas covered by the ISPMA SPM framework. In contrast, the ISPMA SPM framework indicates that Software Product Managers are directly accountable for product strategy and planning, and they either participate in or coordinate the other activities included in the framework. However, the Scrum Guide [SS20] also assigns the PO with the all-encompassing responsibility of maximizing the product's value.

Cross-tabulation showed differences between PO scenarios and their relationship to the surrounding organization. In the Internal Customer scenario, it is assumed that the product is developed for internal use within the organization. The responsibilities related to the business leadership of the product are limited. For example, marketing may be limited to the internal promotion of the product, whereas sales and fulfillment may be limited to the definition of internal Service Level Agreements (SLAs). However, as in any other scenario, the Internal Customer scenario requires the PO to understand user needs, steer development, and communicate the value of the product. The interviewed POs in the Internal Customer scenario were involved in some of these activities, with respondents 11 and 15 being not only involved in but responsible for product planning.

The interviewees in the Compact Organisation scenario are Product Managers as defined by the ISPMA SPM framework, who additionally take on the role of a PO in development

teams. As Product Managers, they are responsible for or participate in, the wide range of activities defined by the ISPMA SPM framework. Respondent 5 explained the practice of organizing 'roadmap meetings' for product strategy and product planning-related decision-making. The roadmap meetings also ensured that the resulting decisions were adequately communicated within the organization. In general, Respondents 5 and 8 indicated active involvement in product strategy, product planning, marketing, sales, and fulfillment, as well as delivery services and support, typically in collaboration with other stakeholders of the organization.

The Separate Product Management scenario and the SAFe-like Organisation scenario have many similarities. In both scenarios, POs are part of development teams and interface with a separate Product Management function. POs in these scenarios are primarily responsible for development activities, with a focus on requirements engineering. Meanwhile, product managers are responsible for product strategy and planning, and they take on the business leadership of the product. According to the ISPMA SPM framework, product management 'orchestrates' product marketing, sales, and fulfillment, as well as delivery services and support. In the Separate Product Management scenario and in the SAFe-like Organisation scenario, the POs participate in related activities as technical experts, but they do not orchestrate or coordinate them. However, the Separate Product Management and SAFe-like Organisation scenarios are not the same. In SAFe, POs take input from the program backlog defined by the product management. In comparison, Respondent 13, representing the Separate Product Management scenario, had a greater degree of autonomy in defining the product roadmap, practically excluding the hardware components of the product.

In the Internet Company scenario, the respondents see themselves as product managers, but they also have a close relationship with the development teams. Respondent 10 is part of a development team, whereas Respondents 14 and 16 hold senior product manager roles and lead initiatives that involve multiple development teams. These teams are organized around business areas, and it's worth noting that the product created by a development team may only be a part of the overall product offered to the market. Consequently, the product created by a development team may differ from what the market perceives as a specific product.

Product managers in the Internet Company scenario are empowered within their teams and business areas. They have clear business objectives to meet. Nevertheless, Respondent 10 explained that many of the aspects of product strategy are defined higher up in the organization. These aspects of product strategy, such as pricing, are broader than the business area of the team, implying that the representatives of this Product Owner Scenario only need to address some of the activities defined in the ISPMA SPM framework. The Product Manager is only responsible for some of the things that would be required for an individually branded, stand-alone product.

To summarise the results of RQ2, there were significant differences in how POs relate to the surrounding organization. In addition to being POs in development teams, the

interviewees representing the Compact Organisation scenario generally fulfill the role of a Software Product Manager as defined by the ISPMA SPM framework. In the SAFe-like Organisation scenario, the PO takes a sharp focus on development. In the Internet Company scenario, development teams have been organized around business areas, allowing each of the development teams to have a Product Manager with meaningful business objectives. Nevertheless, different teams contribute to the overall offering of the company.

It is possible that Internet Companies chose to position Product Managers within development teams in order to emphasize the importance of their role in driving product development and ensuring that the final product meets the needs of the business. By naming the role ’Product Manager’, these companies may have sought to highlight the business leadership aspects of the role, indicating that the Product Manager is responsible not only for overseeing the technical aspects of product development but also for ensuring that the product aligns with the overall business strategy and goals.

Based on the study, the Product Owner is primarily a technical role within software development organizations. However, in the Compact Organisations scenario, the interviewed Product Managers also assumed the role of PO in development teams, similar to the Internet Companies scenario. These scenarios were the only ones where the interviewees assumed ISPMA SPM framework-like responsibilities. Table 3 summarises the results of RQ2.

Product Owner Scenario	Relation of Product Owner role to SPM framework
Internal Customer	The ISPMA SPM framework is only partially applicable in this scenario.
Compact Organisation	The POs assumed the role of a Product Manager as defined in the ISPMA SPM framework.
Separate Product Management SAFe-like Organisation	The POs focused on the development area of the ISPMA SPM framework.
Internet Company	The respondents assumed the role of a Product Manager as defined in the ISPMA SPM framework, although there may be several development teams and Product Managers contributing to the market offering.

Tab. 3: Summary of RQ2 results

5 Summary

The key observations of this research are summarised as follows:

Firstly, if the parties involved in a discussion do not agree on the definition of product value, it is nearly meaningless to talk about maximising it. This paper argues that careless use of the term product value might create a false sense of professionalism that does not exist. Every now and then, the PO should take a step back and think strategically about where the value of the product is and whether there is a way to measure it.

Value is co-created with customers instead of being produced by companies. The roles of the producer and consumer become intertwined in value creation. The authors suggest that a service lens on value creation [BLV14] can help POs to understand the value of the product and support innovation in the software business. Given that the value is highly individual and ultimately judged by the customer, POs can only anticipate value. Nevertheless, the anticipated value should be captured in a value proposition conveying the benefit provided to the customer.

Secondly, appropriately defined metrics can help POs to make informed product decisions, and when linked to an organisation's business objectives, product and business metrics can also add a great deal of depth to the role of a PO. The study found that the POs representing the Internet Company scenario were far ahead of the rest in quantifying product value. However, outside of this scenario, most of the interviewees approached product value by anticipating the product's usefulness or usability, and only a few relied on user-research in their decision-making. The paper questions who would drive the implementation of product analytics if not POs themselves and proposes that POs should consider measuring product value more effectively and making it visible to their teams.

Thirdly, POs representing the SAFe-like Organisation scenario reported a disconnect from the users of the product. In this scenario, the POs mainly interfaced with Product Managers rather than directly with users. Assuming that the objective of the PO is to maximize the usefulness or usability of the product, the disconnect from the users is concerning. Whether this is a common problem in organizations applying the market-leading framework for Large-scale Agile could be dealt with in future research.

Fourthly, according to the Scrum Guide [SS20], the PO is held accountable for maximizing the value of the product. The guide defines the internal responsibilities within the development team, but it does not aim to explain what POs should do to maximize value. Nevertheless, it is a product leadership role that shares many similarities with the role of a Product Manager. The ISPMA SPM framework outlines the activities typically carried out by Product Managers. The organizations represented by the interviewed POs are widely different from each other. In some organizations, POs fulfill the role of a Product Manager as defined by the ISPMA SPM framework. In other organizations, POs focus purely on the development activities of the framework.

Limitations and future work

The selection of participants may pose a threat to internal validity, even though exploratory research does not aim to confirm any causal relationships or provide conclusive results. As discussed in the context of interview planning, the sample is non-statistical, and the representativeness of the sample cannot be guaranteed in terms of

internal validity. Given the heterogeneity of the Product Owner population and the broad scope of the research questions, a larger sample size may have provided new perspectives, but it could also have resulted in many repetitions.

It’s worth noting that multiple respondents represented Organisations A, B, and D in our study. While each respondent provided their own unique perspective, there were no significant discrepancies between those representing the same organization. By using semi-structured interviews, we were able to ask follow-up questions as necessary, which could have increased the internal validity of our results. However, the limitations discussed earlier may reduce the generalisability, or external validity, of our findings. Further research would be required to draw conclusive results.

Conclusions

This paper presents a study on the role of a Product Owner and how it relates to the role of a Software Product Manager. The PO is responsible for maximizing the value of the product. Through empirical inquiry with 16 software development professionals, this study shows that POs have varying perceptions of what constitutes value. Additionally, while the role of a PO overlaps with that of a SPM, the specific responsibilities of a Product Owner vary between different companies.

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Framework für Geschäftsmodelle von Unternehmenssoftwareplattformen

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Abstract: Megatrends like Digitization, Globalization and Customer Empowerment drive companies in the IT Industry to constantly change their business models. In particular, the term “Software Platforms” is still gaining significance in this context. This contribution suggests a fromwork for exploring business models of software platforms for enterprise software. This framework could then represent the basis for an industry comparision and a first step towards the formulation of practical recommendations.

Keywords: Softwareplattformen, Unternehmenssoftware, Geschäftsmodelle

1 Motivation

Megatrends wie beispielsweise die Globalisierung, Digitalisierung oder Individualisierung beeinflussen Unternehmen in nahezu allen Branchen. Technologische Trends wie das Cloud-Computing ermöglichen Unternehmen neue Möglichkeiten zur Genierung von Kundennutzen, birgen aber gleichzeitig auch neue Herausforderungen [Ma15, Pe16]. Der damit einhergehende Wandel verändert Märkte, Wertschöpfungsketten, Unternehmen und deren Geschäftsmodelle [Wi17, VCB14].

Insbesondere Anbieter von Unternehmenssoftware werden mit dieser Thematik konfrontiert. Durch Trends wie dem Customer Empowerment und der Individualisierung werden Softwareprodukte immer häufiger als hybride Leistungsbündel aus Software und ergänzenden Dienstleistungen mit Unterstützung von Komplementoren angeboten, die mit ihren komplementären Produkten und Dienstleistungen großen Einfluss auf den Umsatz und Erfolg der Hersteller haben [Ma15]. Unternehmenssoftwareanbieter haben diese Veränderungen zu berücksichtigen, weshalb sie ihre Geschäftsmodellkonzepte entsprechend anpassen müssen [Pe16].

Daher rücken Geschäftsmodellkonzepte zunehmend in den Fokus der akademischen Forschung, insbesondere als Thema der Wirtschaftsinformatik [PHH12, KT17]. Für die Analyse von Geschäftsmodellkonzepten und dem Vergleich von verschiedenen Geschäftsmodellen, werden geeignete Geschäftsmodellkomponenten benötigt. Allerdings

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besteht auch nach Jahren intensiver Beschäftigung in Wissenschaft und Praxis bisher Unsicherheit darüber, welche Notationselemente relevant sind [KJ12].

Mit dem vorliegenden Beitrag soll folgende die Forschungsfrage beantwortet werden: *Wie können Geschäftsmodelle von Unternehmenssoftwareplattformen beschrieben werden?*

2 Stand der Forschung

2.1 Definition und Bestandteile von Geschäftsmodellen

Unter einem Geschäftsmodell wird ein angewandtes Geschäftskonzept verstanden, welches vereinfacht die wertschöpfenden Abläufe, Funktionen und Interaktionen zum Nutzen der Kunden, der Sicherung von Wettbewerbsvorteilen und der Erlösgenerierung darstellt [10]. Osterwalder und Pigneur definieren: *„Ein Geschäftsmodell beschreibt das Grundprinzip, nach dem eine Organisation Werte schafft, vermittelt und erfasst* [OP11]*.“* Allerdings herrscht in der wissenschaftlichen Literatur keine Einigkeit bezüglich einer allgemeingültigen Definition des Geschäftsmodellbegriffs. Der Begriff des Geschäftsmodells erfährt seit den 1990er Jahren im Zuge von IT-Gründungen zunehmend Beachtung und findet vor allem Eingang in der Wirtschaftsinformatik [Ah16]. Durch Geschäftsmodelle werden Vergleiche unterschiedlicher Unternehmen und Identifizierungen von Synergien zwischen Unternehmen ermöglicht [Po13]. Ein Geschäftsmodell besteht grundsätzlich aus drei Kernelementen [Po13]:

- Das Wertversprechen – legt fest, welchen Nutzen und Wert das Unternehmen insbesondere durch ihre angebotenen Produkte und Dienstleistungen für Kunden und strategische Partner stiftet.
- Die Leistungserstellung – oder Wertschöpfung definiert, wie die angebotenen Leistungen für den Kunden generiert und erbracht werden.
- Das Ertragsmodell – beschreibt, wie mit den angebotenen Leistungen Erlöse erzielt werden sollen [Bu09, Bi17, Al11].

Diese drei Kernelemente werden in vielen Geschäftsmodellansätzen aufgegriffen und finden dabei unterschiedlich starke Beachtung [BRR02, Sc15]. Osterwalder und Pigneur unterteilen das Geschäftsmodell in die Bestandteile „Wertversprechen“, „Schlüsselpartner“, „Schlüsselaktivitäten“, „Schlüsselressourcen“, „Kundenbeziehungen“, „Kundensegmente“, „Wertangebote“, „Kanäle“, „Kostenstruktur“ und „Einnahmequellen“ [OP11]. Diese Gliederung wird im Folgenden zur Entwicklung des Frameworks für Geschäftsmodelle von Unternehmenssoftwareplattformen herangezogen.

2.2 Unternehmenssoftwareplattformen

Als Unternehmenssoftwareplattformen werden nachfolgend Plattformen verstanden, die es – bspw. über das Vorhandensein offener Interfaces – dritten Unternehmen, den sogenannten Komplementoren, ermöglichen, Leistungen auf dieser Plattform zu erbringen bzw. anzubieten. Gawer spricht hierbei von Branchenplattformen (englisch Industry Platforms) als offenste Form der Softwareplattformen [Ma15, Ga14].

3 Entwicklung des Frameworks

3.1 Anforderungen an Geschäftsmodellkomponenten

Für das Geschäftsmodellframework zur Analyse und zum Vergleichen von Geschäftsmodellen von Unternehmenssoftwareanbietern werden nachfolgend in Abschnitt 3.2 die relevanten Komponenten identifiziert. Die Komponenten und ihre Ausprägungen werden durch Geschäftsmodellliteraturanalyse ermittelt und unterliegen gewissen Anforderungen. Die identifizierten Geschäftsmodellkomponenten werden dabei jeweils nach der gleichen Struktur beschrieben. Zunächst werden die einzelnen Komponenten inhaltlich beschrieben, anschließend werden ihre einzelnen Ausprägungen betrachtet [Pe16].

Dabei sollen die ausgewählten Geschäftsmodellkomponenten durch eine überschneidungsfreie Anordnung eine klare Abgrenzung zueinander erhalten [St15]. Zur besseren Übersicht sollen die Geschäftsmodellkomponenten, die zur umfassenden Betrachtung vollständig sein müssen, zudem einer übergeordneten Komponente zuordenbar sein, um diese anschließend übersichtlich zusammenfassen zu können [Pe16].

3.2 Geschäftsmodellkomponenten

Die relevanten Geschäftsmodellkomponenten und ihre Parameterausprägungen werden auf Grundlage, der in Abschnitt 2.1 vorgestellten Bausteine nach Osterwalder und Pigneur ermittelt und sollen dabei die Anforderungen in Abschnitt 3.1 erfüllen. Für eine Geschäftsmodellanalyse sollen die relevanten Bestandteile lediglich eine Parameterausprägung annehmen, wodurch ein Vergleich von verschiedenen Geschäftsmodellkonzepten unterschiedlicher Unternehmenssoftwareanbieter ermöglicht wird.

Bestandteile der Kundensegmente: Die (End-)Kunden sind eine der wichtigsten Komponenten in Geschäftsmodellen, da ohne Kunden kein Unternehmen lange überleben und existieren kann [OP11]. **Zielkunden** von Unternehmen, an die sich die angebotenen Produkte und Dienstleistungen richten, können dabei *Privatpersonen* (B2C), andere *Unternehmen* (B2B) oder der *öffentliche Sektor* (B2A) sein [AS16, MS12, Op05]. Der

B2B-Bereich kann zusätzlich in die Ausprägungen *Großunternehmen, Klein- und mittelständische Unternehmen (KMU)* und *Start-ups* differenziert werden [LHE13].
Zusätzlich lassen sich innerhalb eines **Kundenmarkts** vier Gruppen von Kunden oder Organisationen identifizieren [2]. Dabei wird zwischen dem *Massenmarkt*, welcher sich an eine große Anzahl von Kunden richtet, dem *Nischenmarkt*, welcher sich auf spezifische Kundengruppen oder Märkte mit unbefriedigten Bedürfnissen konzentriert, dem *Differenzierungsmarkt*, welcher eine branchenweite Einzigartigkeit zur Unterscheidung von Wettbewerbern anbietet und dem *diversifizierten Markt*, welcher unterschiedliche und nicht zusammenhängende Marktsegmente bedient, unterschieden [OP11, Ah16].

Bestandteile des Wertversprechens: Die Produkte und Dienstleistungen, die für den Kunden einen Nutzen stiften sollen, sind für das Ziel dieser Arbeit im Bereich der betrieblichen Anwendungssoftware, welche zur Unterstützung und Steuerung betrieblicher Prozesse beitragen soll, zu finden [La09, Ma15]. Relevante betriebliche Anwendungssoftware wird in der Praxis dabei vor allem in *Enterprise-Ressource-Planning-Systemen (ERP-Systeme), Produktionsplanungs- und -steuerungssystemen (PPS), Supply-Chain-Management-Systemen (SCM-Systeme), Customer-Relationship-Management-Systemen (CRM-Systeme)* und neuerdings *Industrie 4.0-Systemen* unterschieden [Le15]. Das Versprechen, mit den angebotenen Produkten oder Dienstleistungen einen Mehrwert für den Kunden zu generieren, unterteilen Osterwalder und Pigneur in elf Ausprägungen, die quantitativer (z. B. Preis, Leistungsgeschwindigkeit) oder qualitativer (z. B. Gestaltung, Kundenerfahrung) Natur sein können. Dabei können Produkte oder Dienstleistungen einen Nutzen stiften, durch ihre komplette *Neuheit*, einer verbesserten *Leistung* gegenüber der Konkurrenz, der maßgeschneiderten *Anpassung* an Kundenwünsche, durch *Erleichterung* der Arbeit, ein überlegenes *Design*, einem bestimmten *Status oder Markennamen*, einem *geringeren Preis* bei gleicher Qualität im Vergleich zur Konkurrenz, einer *Kostenreduzierung* beim Kunden, einer *Risikominderung* beim Kunden, der *Verfügbarkeit* der Produkte und Dienstleistungen für Kunden und der *Anwenderfreundlichkeit* [OP11].

Da unterstellt werden kann, dass individualisierte die spezifischen Kundennutzen einzelner Kunden besser erfüllen können, besteht auch ein Zusammenhang aus der Kundenzufriedenheit und der Individualisierung der Produkte [Go04]. Der Standardisierungsgrad der angebotenen Software kann dabei in *Individualsoftware*, die sich an spezifischen Anforderungen des Kunden orientiert, *Stapelproduktion*, bei der ein Anbieter die Softwarelösung für mehrere Kunden verwenden kann und der *Massenfertigung*, bei der die angebotene Lösung mit zunehmendem Standardisierungsgrad für alle Kunden verwendet wird, unterschieden werden [BDH15].
Bestandteile der Kundenkanäle: Die Vermittlung der angebotenen Produkte oder Dienstleistungen eines Unternehmens kann durch direkten oder indirekten *Vertrieb* erfolgen. Während beim direkten Vertrieb der Endkunde direkt mit dem Hersteller in Kontakt steht, wird beim indirekten Vertrieb ein Händler zwischengeschalten [Pr13, BBL12]. Der ***direkte Vertrieb*** kann unterschieden werden in *Eigenvertrieb*, über eine *eigene Filiale*, über das *Internet*, *mobile Geräte* bis hin zu eigenen *Softwareplattformen*

[1-2]. Beim ***indirekten Vertrieb*** kann das Unternehmen zwischen *Partnerfilialen, Großhändlern, Fremdvertrieb* sowie *elektronischen Marktplätzen* wählen [Pe16, OP11].

Bestandteile der Kundenbeziehungen: In Abhängigkeit der Individualität und Komplexität der angebotenen Produkte und Dienstleistungen, können Kundenbeziehungen verschieden starke Bindungen erreichen [30]. Dabei werden der *persönliche Kontakt* (Ansprechpartner vor Ort), der *digitale Kontakt* (bspw. per E-Mail), der *Selbstservice, Communitys* (Nutzercommunitys in der sich Kunden austauschen können, angelegt von den Anbietern), *Support* (bspw. Hotlines, FAQs, usw.) und die *Mitbeteiligung* (Erkenntnisgewinne durch Mitbeteiligung der Kunden am Wertschöpfungsprozess) unterschieden [Pe16, OP11].

Bestandteile der Einnahmequellen: Einnahmen entstehen beim Verkauf von Gütern als Produkt aus Verkaufspreis und Absatzmenge [31]. Daher müssen Unternehmen zunächst den optimalen Verkaufspreis für ihre Produkte und Dienstleistungen festlegen, welcher ihren Gewinn daraus maximiert [Pu09, Be12]. Dafür muss das Unternehmen die grundsätzliche **Preispositionierung** im Rahmen der Preispolitik definieren. Hier stehen die *Hochpreis*- (hohe Qualität, hoher Preis), *Mittelpreis*- (etwas geringere Qualität, geringerer Preis) und *Niedrigpreisstrategie* (niedrige Leistung, niedriger Preis) zur Verfügung [MBH15, Li16].

Unternehmenssoftware lässt sich in Ausführungen mit unterschiedlich ausgeprägten Funktionen anbieten, weshalb sie zu unterschiedlichen Preisen angeboten werden kann. Diese **Preisdifferenzierungsformen** lassen sich in drei Ausprägungen eingrenzen: die *Preisdifferenzierung* (räumlich, zeitlich, abnehmerorientiert oder mengenorientiert), bei der Kunden unterschiedliche Preise für Produkte oder Dienstleistungen bezahlen müssen (bspw. in geografisch abgetrennten Märkten, in Abhängigkeit des Kaufzeitpunkts oder in Abhängigkeit der abgenommenen Menge (Flatrate)) [MBH15, SF16], die *Preisbündelung*, bei der Kunden mehrere separate Produkte in einem Bündel zusammengefasst zu einem Bündelpreis erwerben können und dem *Revenue Management*, bei der Kunden in Abhängigkeit von ausgelasteten Kapazitäten unterschiedliche Preise bezahlen müssen [Pe16, Ho17].

Nach der Definition des optimalen Verkaufspreises muss zur Ermittlung der Einnahmen die **Absatzmenge** betrachtet werden. Die Absatzmenge kann hierfür die Ausprägungen *Niedrig, Mittel* und *Hoch* annehmen, welche selbsterklärend sind [BDH15].

Zudem lassen sich Erlösquellen und -modelle differenziert betrachten [38]. Hierbei kann festgestellt werden, aus welchen Erlösquellen das Unternehmen den Hauptteil ihrer Einnahmen generiert. Einnahmen können durch verkaufte Produkte und angebotene Dienstleistungen (Beratungen, Support, Implementierungen, etc.) generiert werden, aber auch durch das Anbieten von Add-Ons (Zusatzoptionen und Extras), Vermittlungsgebühren oder durch Werbung [Pe16, OP11, Kr05]. Bei den Erlösmodellen werden die Struktur des Zahlungsstroms und die **Bemessungsgrundlage** unterschieden [Ma15]. Für die Struktur des Zahlungsstroms werden die Einmalzahlung mit unbegrenzter

Nutzungsdauer, die wiederkehrende Zahlung (bspw. Jahresgebühr) oder eine hybride Kombination aus beiden Varianten unterschieden [Pe16]. Für die Bemessungsgrundlage, die besagt wie aus einer Erlösquelle Umsatz realisiert wird, kann zwischen nutzungsabhängig (Erlös auf Basis des Umfangs der Leistung), nutzungsunabhängig (Grundgebühr) und ergebnisabhängig (Preis auf Basis erbrachter Leistung) unterschieden werden [Ma15].

Bestandteile der Schlüsselaktivitäten: Damit das Geschäftsmodell eines Unternehmens funktionieren kann, muss das Unternehmen eine Reihe von Schlüsselaktivitäten erbringen. Für einen Softwarehersteller umfassen die Schlüsselaktivitäten die Softwareentwicklung [OP11]. Da Softwarehersteller zunehmend hybride Leistungsbündel aus Software und ergänzenden Dienstleistungen anbieten und dabei von Komplementoren profitieren, bezieht sich die Schlüsselaktivität hier auf das Plattformmanagement als Softwareplattformbetreiber [Ma15, OP11]. Als Plattform werden softwarebasierte Produkte oder Informationssysteme definiert, die die Basis für Leistungen interner und externer Akteure darstellen [Ma15]. Hierbei lassen sich zwei grundsätzliche **Plattformtypen** voneinander abgrenzen: *Produktplattformen*, die die effiziente Wiederverwendung bereits erstellter Module ermöglichen und *Branchenplattformen*, die offen für komplementäre Produkte bzw. Services von Dritten zur Erweiterung sind [BDH15].

Zu den Schlüsselaktivitäten eines Unternehmens gehört zudem die **Unterbreitung des Wertangebots** an den Kunden. Hierbei haben sich drei Möglichkeiten herauskristallisiert, wie Softwareanbieter ihre Produkte vertreiben können. Zum einen das lizenzbasierte Nutzungsmodell, bei dem Software zunächst vom Anwender käuflich erworben, selbst betrieben und *„On-premise-Software“* genannt wird. Neben dem einmaligen Bezahlen der Programmlizenz fallen im Laufe der Nutzungsdauer lediglich Wartungsgebühren an. Dem gegenüber steht der Trend mit dem Überbegriff „Cloud-Computing“, bei dem Software im Gegensatz zu traditionellen Lizenzprodukten gemietet und durch den Provider in einer Public Cloud betrieben wird, wobei hier von *„On-demand-Software“* gesprochen wird [BDH15, Be15, Pu15]. Durch Verschmelzungen zwischen den beiden Vertriebsmöglichkeiten besteht zudem eine *hybride Kombination* [Pu15].

Eine weitere Schlüsselaktivität besteht für Softwarehersteller im Bereitstellen zusätzlicher Dienstleistungen, wie beispielweise Schulungen, Hotlines, Wartungs- oder Weiterentwicklungsverträge, die zur Erhöhung der Kundenzufriedenheit beitragen sollen [42]. Gesondert können hierbei Instandhaltungs- und Supportmodelle betrachtet werden. Das **Instandhaltungsmodell** beschreibt dabei die Häufigkeit neuer Produktversionen, mit den Parameterausprägungen *Täglich*, *Wöchentlich*, *Monatlich*, *Quartalsweise*, *Halbjährlich* oder *Jährlich* [27]. Das **Supportmodell** beschreibt den angebotenen Support eines Unternehmens, mit den Ausprägungen *Standardsupport*, *kundenindividueller Support* und einer *hybriden Kombination* der beiden Supportmöglichkeiten [BDH15].

Bestandteile der Schlüsselpartner: Softwareanbieter agieren heute nur noch selten als eigenständige Einheiten, die Software bzw. Dienstleistungen komplett eigenhändig

erbringen können. Vielmehr agieren ihre entwickelten Softwareprodukte (z. B. ein ERP-System) als Softwareplattformen, die durch Leistungen von Komplementoren erweitert werden können, wie bereits vorher beschrieben [Ma15]. Sie sind daher zunehmend von Partnern abhängig, die mit ihren komplementären Produkten und Dienstleistungen einen Wertbeitrag zum Geschäftsmodell der Softwareanbieter liefern [OP11, Hi12, BHP04]. Daher stellen die Schlüsselpartner einen wichtigen Bestandteil in Geschäftsmodellen von Softwareanbietern dar. Zunächst ist die **Anzahl der Partner**, die komplementäre Softwareprodukte oder Dienstleistungen anbieten, von Relevanz. Die Ausprägungen *Keine*, *Einer*, *Wenige* und *Viele* sind dabei selbsterklärend [BDH15].

Diese Partner liefern für das Geschäftsmodell eines Softwareanbieters einen nützlichen Beitrag und gehen dabei verschiedene Formen von Netzwerken ein. Diese **Partnernetzwerkformen** lassen sich in *strategische Allianz* (freiwillige und langfristige Partnerschaft zwischen zwei oder mehreren Unternehmen zur Sicherung von Wettbewerbsvorteilen), *Koopkurrenz* (temporäre Kooperation mehrerer Unternehmen, die ansonsten in Konkurrenz zueinander stehen), *Joint Venture* (mehrere Unternehmen agieren als Partner, handeln aber weiterhin als eigenständige Unternehmen), *Käufer-Anbieter-Beziehungen* (kurzfristige Existenz einer Kooperation um eine zuverlässige Versorgung von Produkten und Dienstleistungen zu gewähren) und *Offene Partnerschaften* (Akteure von außerhalb werden zur Leistungserstellung in das Unternehmen miteinbezogen, um eigene Effizienz zu erhöhen) unterscheiden. Jede dieser Partnerschaftsformen haben Vorteile für die beteiligten Akteure [Pe16, CC12].

Die Ausgestaltung dieser Partnerschaften lassen sich durch Wertschöpfungsarchitekturen beschreiben, durch die das Unternehmen Kernaktivitäten festlegt, auf welche es sich selbst fokussieren und welche es an Partner weitergeben will.

In der Literatur werden vier mögliche **Wertschöpfungsarchitekturtypen** definiert: der *Layer Player* (Schichtenspezialist) ist ein spezialisiertes Unternehmen, das sich nur auf eine Stufe der Wertschöpfungskette konzentriert, ein *Orchestrator* koordiniert die besten Eigenschaften von Partnerunternehmen und bildet daraus ein Wertschöpfungsnetzwerk, der *Integrator* führt eine Vielzahl aller Aktivitäten in Eigenleistung durch und der *Market Maker* fügt bestehenden Wertschöpfungsarchitekturen weitere Wertschöpfungsaktivitäten bei [Pe16, BBB12, Al13].

Bestandteile der Kostenstruktur: Als letzter Bestandteil von Geschäftsmodellen wird die Kostenstruktur betrachtet. Um den Gewinn eines Unternehmens zu bestimmen, müssen von den erzielten Einnahmen, die oben beschrieben werden, die Kosten subtrahiert werden [Ta06]. **Geschäftsmodellkostenstrukturen** können dabei kosten- oder wertorientiert sein. Bei der *Kostenorientierung* versucht das Unternehmen seine Kosten zu minimieren, während bei der *Wertorientierung* ein erstklassiges Wertangebot mit persönlichem Service für höhere Kosten sorgt, Unternehmen diese aber aufgrund der Qualitätsvorteile gegenüber der Konkurrenz unbesorgt hinnehmen. Auch hier liegen viele Geschäftsmodelle zwischen diesen beiden Ausprägungen und bilden eine *hybride Kombination* [OP11]. Zur Analyse von Geschäftsmodellen von

Unternehmenssoftwareanbietern liegt der Fokus auf den **Kostentreibern**, den Bereichen eines Unternehmens, die die Kosten für das Geschäftsmodell hauptsächlich verursachen. Die Kosten können aus den Bereichen der *Forschung & Entwicklung*, *Marketing & Vertrieb*, *Support*, sowie aus *Beschaffungs*- und *Third Party Kosten* stammen [BDH15].

3.3 Zusammenfassung der Geschäftsmodellkomponenten

Ziel dieses Abschnitts ist die Zusammenführung aller beschriebenen Bestandteile aus den vorherigen Abschnitten zu einem Framework, auf dessen Grundlage eine Analyse und ein Vergleich verschiedener Geschäftsmodelle von Unternehmenssoftwareanbietern möglich ist. Allerdings können nicht alle Anforderungen an Geschäftsmodellkomponenten erfüllt werden. Die Abgrenzung zwischen den einzelnen Bestandteilen gestaltet sich schwierig und lässt Interpretationsspielraum [Pe16]. Beispielsweise lassen sich die Bestandteile der Schlüsselressourcen nicht durch eine einzelne Ausprägung beschreiben, da für jedes Geschäftsmodell physische, intellektuelle, menschliche und finanzielle Ressourcen nötig sind. Die Übersichtlichkeit lässt sich durch eine Einteilung in vier Hauptbereiche anhand von Zielfragen nach Osterwalder bzgl. „Produkt", „Kundenschnittstelle", „Infrastrukturmanagement" und „Finanzielle Aspekte" herstellen [OP11, SEB14]. Mithilfe dieser vier Hauptbereiche lassen sich die identifizierten Bestandteile von Geschäftsmodellen übersichtlich zu einem Framework, siehe folgende Tabelle, zusammenführen:

Produkt									
Art der Anwendung	ERP	PPS	SCM	CRM	Industrie 4.0				
Nutzenversprechen	Neuheit	Leistung	Anpassung	Arbeit erleichtern	Design	Marke/Status			
	Preis	Kostenreduktion	Risikominderung	Verfügbarkeit	Anwenderfreundlichkeit				
Standardisierungsgrad	Individuelle Produktion	Stapelproduktion	Massenproduktion						
Kundenschnittstelle									
Kundenbeziehung	Persönlicher Kontakt	Digitaler Kontakt	Selbstservice	Communitys	Support	Mitbeteiligung			
Zielkunden	B2A	B2B	B2C						
	Öffentlicher Sektor	Großunternehmen	KMU	Start-Up	Privatverbraucher				
Kundenmarkt	Massenmarkt	Nischenmarkt	Differenzierung	Diversifikation					
Kundenkanäle	Direkter Vertrieb					Indirekter Vertrieb			
	Eigene Filiale	Eigenvertrieb	Internet	Mobil	Softwareplattformen	Partnerfilialen	Großhändler	Fremdvertrieb	Elektronische Marktplätze

Infrastruktur Management						
Anzahl der Partner	Keine	Einer	Wenige	Viele		
Partnernetzwerke	Strategische Allianz	Koopkurrenz	Joint Venture	Käufer-Anbieter-Beziehung	Offene Partnerschaft	
Wertschöpfungsarchitektur	Layer-Player	Orchestrator	Integrator	Market-Maker		
Plattformtypen	Produktplattform	Branchenplattform				
Vertriebsmöglichkeit	On premise	Hybride Kombination	On demand			
Instandhaltungsmodell	Täglich	Wöchentlich	Monatlich	Quartalsweise	Halbjährlich	Jährlich
Supportmodell	Standardsupport	Hybride Kombination	Kundenindividueller Support			
Finanzielle Aspekte						
Kostenstruktur	Kostenorientiert	Hybride Kombination	Wertorientiert			
Kostentreiber	Forschung & Entwicklung	Marketing & Vertrieb	Support	Beschaffungskosten	Third-Party-Kosten	
Preispositionierung	Hochpreisstrategie	Mittelpreisstrategie	Niedrigpreisstrategie			
Preisdifferenzierungsformen	Preisdifferenzierung	Preisbündelung	Revenue Management			
Absatzmenge	Niedrig	Mittel	Hoch			
Erlösquelle	Produkt	Dienstleistung	Add-On	Vermittlung	Werbung	
Erlösmodelle	Zahlungsstrom			Bemessungsgrundlage		
	Einmalzahlung	Hybride Kombination	Wiederkehrende Zahlungen	Nutzungsabhängig	Nutzungsunabhängig	Ergebnisabhängig

Tab. 3: Framework zur Beschreibung und Analyse von Geschäftsmodellen

4 Kritische Würdigung

Auf Basis neun generischer Komponenten eines Geschäftsmodells konnten im vorliegenden Beitrag spezifische Ausprägungen von Geschäftsmodellen im Kontext von Unternehmenssoftwareökosystemen definiert und in einem Framework zusammengefasst werden.

Dabei ergab sich, dass eine Vielzahl von möglichen Geschäftsmodellbestandteilen existieren, die unterschiedliche Relevanz für die Geschäftsmodellanalyse und den Geschäftsmodellvergleich von Unternehmenssoftwareanbietern haben.

Das Framework liefert damit einen Ansatz zur Bewertung von unterschiedlichen Geschäftsmodellkonzepten. Die große Anzahl der möglichen Geschäftsmodellbestandteile lassen allerdings weitere Gestaltungsmöglichkeiten für Frameworks zur Geschäftsmodellanalyse zu.

Die Thematik der Geschäftsmodelle wird durch den zunehmenden digitalen Wandel und im Hinblick auf die Digitalisierung (bspw. bekannt unter dem Schlagwort „Industrie 4.0“) weiterhin an Wichtigkeit gewinnen, da sich die Geschäftsmodelle von Unternehmen noch flexibler anpassen müssen. Auch die Softwarebranche wird zukünftig von diesen

Veränderungen betroffen sein. Die Unternehmen müssen bei der Gestaltung ihrer Geschäftsmodelle flexibel, intelligent und kreativ auf den Wandel reagieren, um ihren Unternehmenserfolg nicht zu gefährden. Durch die zukünftigen Veränderungen der Geschäftsmodelle werden sich allerdings auch die relevanten Bestandteile von Geschäftsmodellen ändern. Für die akademische Forschung bestehen somit weitere Forschungsmöglichkeiten und Untersuchungsansätze.

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ISSN 1617-5468
ISBN 978-3-88579-728-9

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