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AI and ML for Software Product Management: A Framework for Emerging Challenges

Master's thesis in Computer Science and Engineering

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Abstract

In the rapidly evolving landscape of software product management (SPM), the integration of artificial intelligence (AI) and machine learning (ML) presents both unprecedented opportunities and significant challenges. This thesis investigates the impact of AI and ML on SPM practices and develops a comprehensive framework tailored to address the emerging needs of this dynamic field. Utilizing a mixed-method approach, the study first conducts a systematic literature review to identify the current utilization and challenges of AI and ML within SPM. This is followed by empirical data collection through interviews with professionals in the field, ensuring a robust foundation for framework development. The research findings reveal that while AI and ML can significantly enhance decision-making and efficiency in SPM, they also introduce complexities related to integration, ethics, and management. In response, this thesis proposes a novel SPM framework that incorporates how SPM should use AI and ML components and tools effectively, focusing on enhancing SPM and aligning with digital transformation and digitalization goals. The framework is validated through a workshop and an interview with experts in the field. This study aims to bridge a crucial gap in academic literature and to also offer practical insights for individuals and organizations aiming to leverage AI and ML for enhanced SPM strategies, ensuring both competitive advantage and alignment with evolving technological landscapes.

Keywords: Software Product Management, Artificial Intelligence, Machine Learning, Framework, Digital Transformation, Digitalization.

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Julia Jönmark & Hanna Söderström, Gothenburg, June 2024

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1
Introduction

Digital transformation, driven by technologies such as artificial intelligence (AI) and machine learning (ML), introduces new possibilities for organizations, transforming them from a traditional company to a digital company [1]. This shift impacts all departments, creating new opportunities and challenges, while enabling products to be improved or extended more easily and allowing for rapid adjustments, continuous improvements, and predictive maintenance [3]. Digitalization refers to converting information into digital formats with the help of digital tools like AI and ML [1][3]. This is in contrast to digital transformation which involves a comprehensive integration of digital technologies into all aspects of an organization, fundamentally changing how the whole organization operates.

Data is a cornerstone of digitalization and plays a large role in determining companies' success [1][3]. It offers new opportunities for companies to gather more insights about their customers' behavior as well as make informed decisions based on the customer data. Data is the foundation that technologies such as AI and ML are built upon and can be used to further improve and develop these technologies [4]. The importance of good quality data is vital for building successful and unbiased AI and ML tools and components since data lays the foundation for these technologies.

AI and ML are technologies that have gotten a larger significance within several different domains because of the capabilities that they bring as well as being drivers for digital transformation and digitalization [1][3]. However, AI and ML also bear tough challenges that organizations need to consider when implementing the technologies into their products and processes. Among other things, the results of AI and ML can be difficult to trust and understand and it can therefore be problematic to use the results in various processes and activities. The ethical aspects of AI and ML are another challenge that needs to be addressed [5]. Concerns such as transparency, security, and privacy are all critical to making sure that the new technologies are used in ways that do not intervene negatively in any ethical aspect.

Software product management (SPM) is a field within software development that is responsible for the entire process from the ideation to the retirement of a product [6]. SPM targets both the business aspect as well as the technical aspect of the product and works to ensure economic success. Digitalization is affecting how software engineering is done [7]. Software can be updated more frequently, allowing customers' expectations of the product to evolve more rapidly. This leads to a change of focus for companies from selling products to providing more services, and there is a

higher focus on customer-driven innovation [7]. Furthermore, the size of the software is increasing which leads to the need for new architectures and development processes, and the speed of development is an increasingly important factor. Software development is changing, and the field of SPM is required to change along with it. Software systems can do more than before which changes the requirements for SPM.

Different frameworks have been developed for SPM to ensure the success of the product and to enforce some kind of structure in the field. The Reference Framework [8], the ISPMA SPM framework [2], and the Pragmatic Marketing Framework [9] are a sample of the many. With digitalization, the work processes and the products provided are developing, and therefore there is a need for a new framework that takes advantage of the benefits of the new technologies to maximize their advantages. However, the existing frameworks do not take into consideration the involvement of AI and ML technologies within the products and the effects these components have on the work in SPM, and therefore there is a need for a new framework that can help to acknowledge and address the shift that is currently happening.

1.1 Purpose of the study

This study aims to identify the changes that products containing AI ML components introduce to the field of SPM. The goal is also to understand how AI and ML tools are used within SPM today, what challenges they introduce, and possible use cases for them in the future. Based on the results of that research, construct an SPM framework that adequately addresses the changes that AI and ML introduce to the products and processes within the field as well as guiding individuals and organizations through their journey of implementing AI and ML.

1.2 Research questions

This thesis explores the changes that AI and ML components and tools bring to the field of SPM and how these new technologies can be utilized to maximize their advantages. The following are the research questions this study aims to answer:

- **RQ1:** What challenges does software product management face when using AI and ML in both products and processes?

The field of SPM has evolved, presenting new challenges alongside innovations. With the emergence of AI and ML as both product components and tools in SPM processes, the first research question aims to explore the challenges people within the field encounter.

- **RQ2:** How is software product management taking advantage of AI and ML within the products which they are responsible for?

The goal of the second research question is to understand how SPM changes when working with products containing AI and ML components and to see what advantages there are with using AI and ML within products.

- **RQ3:** How is software product management leveraging AI and ML tools today, and what are the use cases for the tools in the future?

The third research question aims to investigate the current stage of AI and ML tools within the field of SPM. Its objective is to understand how SPM utilizes the tools today and in what kind of activities they are used. Furthermore, the aim is to explore potential future use cases for the tools. This research question differs from the second research question by focusing on the usage of AI and ML tools instead of focusing on how AI and ML components within products can be taken advantage of within SPM.

1.3 Significance of the study

There has not been much research on the effects of AI and ML within SPM. Therefore, this thesis will help other researchers gain more knowledge to take this subject further. This study will contribute to bridging the gap in the literature when it comes to managing products containing AI and ML components, as well as, the utilization of AI and ML tools within SPM.

A fundamental for AI and ML is data [4]. Without enough good quality data, the technologies are not able to present good, unbiased results that can be used to enhance customer satisfaction and increase product value. This study brings up the importance of data within SPM and the role that it plays in utilizing AI and ML.

Different SPM frameworks have been developed throughout the years to provide some sort of structure within the field and to help ensure the success of products [2]. The framework created in this research will help people within SPM to better understand how to effectively handle the changes that AI and ML components bring and how to implement AI and ML tools within the field.

1.4 Structure of the report

In Chapter 2, relevant literature is reviewed to provide background information for the study. Chapter 3 will outline the methodologies utilized throughout the thesis. Chapter 4 will present the findings derived from these methodologies as well as the answers to the thesis research questions. This is followed by Chapter 5 which focuses on the empirically derived software product management framework. A discussion of these results, as well as key contributions and future research, will be presented in Chapter 6, and finally, Chapter 7 will present the thesis' conclusions.

2
Background

The following chapter will present relevant literature that provides a background that supports and serves as the foundation for the thesis. Research and information will be introduced and described in order to provide a comprehensive understanding of the material guiding this research.

2.1 Digital transformation

Digital transformation is the integration of digital technology into all areas of an organization and how it fundamentally changes how the organization operates and delivers value to the customers. Digital transformation brings a lot of benefits to organizations. Some of the main benefits are new revenue streams, increased customer relations, and value creation [1][3]. By successfully exploiting data, introducing AI technologies, and becoming more data-driven, companies can gain the benefits of digital transformation. However, where there are new benefits there are often challenges that come to light and digital transformation is no exception. Organizations need to navigate how to evolve their existing ecosystems and simultaneously create new ones that revolve around new emerging technologies [3]. The emerging technologies require new competencies and people need to learn how to use and integrate these into existing systems and products. This can be a challenge for organizations.

There are different steps a company has to take to become fully digitalized, see Figure 2.1 [1][3]. Companies can start at different steps depending on the type of the company [1].

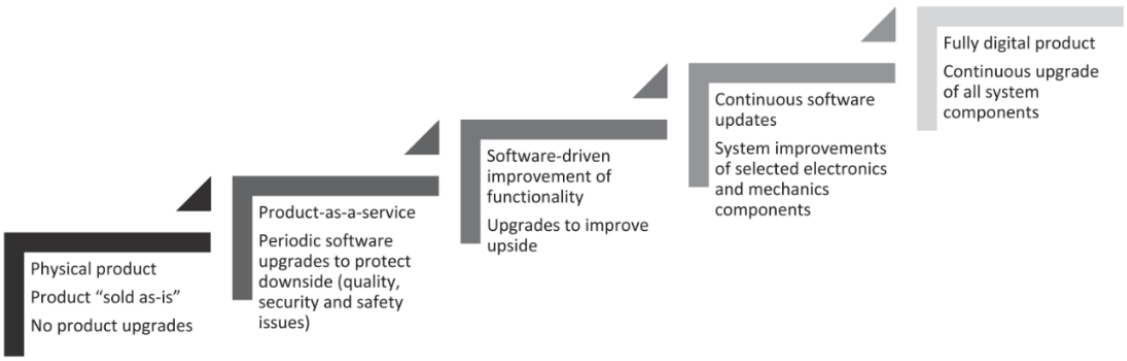

Figure 2.1: The steps through which companies evolve from a traditional to a digital company [1]

The initial step is *Physical product*, focusing on selling physical products [1]. The products are developed and sold with their core functionalities and features, without significant emphasis on digital upgrades. The second step is *Product-as-a-service* where products begin to be offered as services, an important step in the digital transformation journey. An example is the evolution of traditional book publishing into e-book subscription models. This transformation reflects a shift from selling physical books to providing access to a vast library of digital content on a subscription basis. This step often includes software upgrades that can improve system performance in terms of quality, security, and safety. The middle step is *Software-driven improvements of functionality* where the companies focus on the services around the product rather than the product itself. The fourth step is *Continous software updates* and focuses on using customer-generated data from the use of the product and its services for internal benefits, for example, improving product performance. The final step in the digital transformation process is *Fully digital product* which is when the product offering becomes completely digitalized. The company manages both the physical product and its digital upgrades, leading to a scenario where the customer enjoys continuously improving solutions of all system components.

Digital transformation brings many benefits and new challenges, but regardless of the challenges, companies need to start their digital transformation journey to not fall behind [1][3]. They need to continue to evolve and find new ways to stay competitive in the market.

2.1.1 Industry 4.0

The fourth industrial revolution, called digitalization, is happening right now [10]. Digitalization is connected to digital transformation but is more about enhancing current processes with digital tools through automation without affecting the whole business domain. Through time there have been three waves of industry revolutions and new technologies triggered all of them.

The first industry revolution, *Mechanization*, was triggered by the invention of the steam engine [10]. This revolution marked the shift from human manual labor to the broad use of machines in production, significantly improving production efficiency and releasing humans from heavy manual labor. The second industry revolution, *Electrification*, was marked by the invention and use of electric power along with the assembly line [10]. This revolution led to the mass production of products, marking a shift from early craft production to more productive mass production and associated product standardization. The third industry revolution, *Informatization*, was initiated by the development of programmable general-purpose digital computers [10]. This revolution began the era of leveraging machine intelligence to explore and leverage the power of information, significantly improving efficiency in industrial production and other human activities. The third revolution is the catalyst for the fourth industrial revolution.

The fourth industry revolution, *Digitalization*, encompasses the convergence of dis-

ruptive digital technologies such as the Internet of Things (IoT), AI, and blockchain, among others [10][11]. It is leading to unprecedented paradigm shifts in the economy, business, society, and individuals. Central to the fourth industrial revolution is digital engineering transformation, which involves the digitalization of engineering processes and artifacts. This transformation includes the digital representation of engineering artifacts, the development of models and simulations, and the sharing of data across engineering lifecycle and organizational boundaries. The digital, smart, and connected environment of the fourth industrial revolution introduces new challenges related to trust and security. This includes ensuring the authenticity and integrity of digital artifacts and the use of technologies like blockchain for trust management.

Each industrial revolution was triggered by groundbreaking technological innovations (e.g., the steam engine, electric power, computers, and IoT/AI) [10]. These technologies fundamentally changed how production processes and broader economic activities were organized. Each revolution led to significant paradigm shifts in industrial operations, moving from manual labor to mechanization, then to mass production, informatization, and finally to digitalization and smart systems. These shifts represented a continuous evolution towards increasing automation, efficiency, and sophistication in production and organizational processes.

2.1.2 The importance of data

Data is the cornerstone of digital transformation and digitalization, providing the raw material for AI and ML systems that drive modern SPM. As businesses transition from traditional models to digital-first operations, the strategic use of data becomes a critical factor in determining their success [1][3].

The data increase in the digital age offers opportunities for businesses to gain insights and improve decision-making. According to [4], effective data management is important for businesses undergoing digital transformation. It enables companies to harness large volumes of data, apply analytics, and generate actionable insights that can lead to innovative solutions and competitive advantages. Despite the potential benefits, many organizations face significant challenges in managing data effectively. These challenges include integrating diverse data sources, ensuring data quality, and protecting data privacy [3]. The complexity of these challenges requires a robust strategy for data management that encompasses technological solutions and organizational changes.

The integration of data into all aspects of the business lifecycle is important for achieving a seamless digital transformation [4]. From product development to customer engagement and service delivery, data-driven strategies must be implemented to ensure coherence and alignment with business objectives.

2.1.3 DevOps in Automation

Digital transformation is essentially about creating new opportunities for organizations by introducing new technologies. Automation is a pillar for ensuring efficiency, speed, and reliability of the business and development processes [12]. The implementation of DevOps, a cohesive blend of development and operations, exemplifies this by automating key aspects of software delivery and infrastructure management.

DevOps is a tool for improving collaboration between traditionally siloed teams [1][3]. By automating processes with DevOps practices such as continuous integration, continuous deployment, and continuous delivery, DevOps reduces the lead time for changes, thereby accelerating the delivery cycle and becoming more efficient [12]. This helps development teams and IT operations in their collaboration to build, test, and release software more rapidly and reliably [1][3]. It aims to shorten development cycles, increase deployment frequency, and create more dependable releases in alignment with business goals.

DevOps significantly increases a company's operational agility, enabling quick adaptation to changing market conditions and customer expectations [3]. This agility is achieved through streamlined processes involved in software development and deployment, ensuring that businesses can leverage new opportunities more efficiently and increase product value. In the digital economy, where speed and adaptability are paramount, DevOps provides the necessary tools for businesses to stay competitive and responsive. Overall, the integration of DevOps into digital transformation strategies is not merely about adopting new tools but embracing a transformative approach that optimizes and automates the software development lifecycle.

2.2 Artificial Intelligence and Machine Learning

AI has captivated the interest of humanity for an extended period. The term AI was initially introduced by Alan Turing in 1950 with his question, *Can a machine think?* [13][14]. AI encompasses a large area within computer science to enable machines to mimic human intelligence. There are many different ways to define AI. Namatherdhala *et al.* [13] defines AI as *a machine's ability to imitate human intelligence.* Another definition by Cintrón [15] is *AI refers to a technological system that can interpret and learn from external data.* AI is often used as an umbrella term that covers different technologies that can self-learn and reach similarities with human intelligence [14][16]. ML is one of those technologies that are often associated with AI.

ML is one of the most well-known areas of AI [13]. ML is defined by Fredström *et al.* as *the machine's ability to keep improving its performance without humans having to explain exactly how to accomplish all the tasks it's given* [14]. Another definition by Namatherdhala *et al.* of ML is *Machine learning is the algorithms that incorporate intelligence into the machine by automatically learning from data* [13]. ML can be used to predict when equipment is likely to fail, which helps in scheduling maintenance activities proactively, thus reducing downtime and maintenance costs.

A lot of tools are being developed at the moment that use AI and there are different types of tools that use various kinds of AI. Generative AIs are capable of generating new content, such as images, text, and videos that resemble human-generated content [17]. Then there is Natural Language Processing which is a tool that can understand, interpret, and generate human languages [18]. Another category of AI tools is Computer Vision, which is a tool that can interpret and understand the visual world. An example is identifying objects [19]. There is also Speech Recognition that can convert spoken language into text [20]. Examples of tools that use some of these AI technologies are ChatGPT and Microsoft Teams transcription service [17][21].

2.2.1 Ethical aspects of AI and ML

AI and ML touch many aspects of humanity and it raises fundamental questions about the systems deployed, their behavior, the risks they carry, and the control we have over them [5]. As AI and ML continue to advance, ethical concerns are arising. At the moment there are no long-term accepted methods for using technologies such as AI and ML [22]. Some ethical concerns regarding AI brought up by Cenaj and Yunitsyna, are accountability, transparency, privacy, security, and bias. Saurabh *et al.* [5] also mentioned all of those concerns in their article but they also name a few other concerns like responsibility and discrimination.

The question of accountability in AI systems arises from the difficulty in pinpointing responsibility for decisions made by AI [5][22]. This includes determining who is accountable for the actions of AI, which can become increasingly complex as AI systems become more autonomous. AI systems, particularly those based on complex algorithms, can operate as black boxes which is not understandable for humans [5]. This lack of transparency raises ethical concerns regarding the ability to evaluate AI decisions. Privacy is another ethical concern since AI systems often require collecting and processing vast amounts of personal data, raising significant privacy concerns. The ethical handling of such data, including issues of consent, data protection, and the right to privacy, is something to consider when it comes to AI in development and deployment. Security is an ethical concern that is highly connected to privacy. It is to ensure robust security to protect AI systems and the data they handle. AI systems can have both existing biases or introduce new ones if they are trained on biased data sets or designed without consideration of diversity and inclusivity. Biases within AI systems can result in discriminatory outcomes in various applications.

For companies, AI ethics means constructing some sort of policy or code of conduct for how to use AI in every division and task within the company [5]. What is important when writing these policies is to address the concerns and that AI tools should not compromise human rights.

2.3 Software product management

Product management has a longstanding history, and the emergence of SPM methodology stems from its recognition of the significance of software across various domains [6]. Compared to other products, software products present different and unique capabilities that require methods other than traditional product management processes for ensuring success in development [2][23][24]. An example of these unique capabilities are that software products can be updated more often. Software becomes more and more important for various industries and increases the need for technical and cultural changes in the organization.

The concept of SPM is to manage a software product during its entire life cycle correspondingly to the organization's objectives [2]. It is also to be involved in, among other things, the development of the product, as well as the market strategy, product portfolio, launch planning, and communication with external and internal stakeholders [24][25][26][27]. The ultimate goal is to ensure product success economically by the profits that it generates for the company [2][27][28]. SPM focuses on both the technical and the business aspects of a product by involvement in several different activities [23]. The role within SPM can vary depending on the product and the company culture, and therefore the organization needs to define the role if they wish to implement it into their structure [2]. The role in the field is cross-organizational where the people working within it need to have good communication skills to be able to work effectively between the different units in the organization [2][24].

As a result of the rapid changes in the market due to technological aspects, companies often need to make decisions during uncertain times and it is therefore important to have some sort of strategy that will decrease the risk of economic failure [29]. The individual within SPM is responsible for creating a strategy for their product as well as keeping it up to date with changes and support.

SPM regards both technical and business aspects of a product's entire lifecycle, from idea creation to retirement. This means that several different activities are involved within the field of SPM. A person who works with SPM can have different objectives [2]. According to [2] there are three various types of focuses for this role. Business aspects, product contents, and product marketing. Within strategic SPM, the business aspects are of higher prioritization than the other areas, whilst for technical SPM, product contents are more important. For a Product Marketing Manager, product marketing is of the highest priority.

SPM has responsibilities over the features that the concerned product intends to contain based on the research and understanding of the market and the customers' needs. Research has shown that about 50% of the features developed are never used and that they instead add to the complexity of a product [30]. The field of SPM takes care of prioritizing which features should be developed first and which features should not be developed at all. Software contains components of various

kinds depending on the product. Because these products can be easily updated and released, there is the possibility to add, remove, and adjust the features often [30]. With this, there is an opportunity to test features with some users to ensure that they add product value before releasing the new update of the product to all users.

In [23], the authors present four different roles that a person can take within SPM. These roles are expert, strategist, leader, and problem solver and are derived from the essential characteristics that were found during a grounded theory analysis. These characteristics were; influence on the product, authority, access to resources, and influence on collaboration. If a person is defined as an expert, the person has good knowledge of business or development and has less responsibility in SPM activities such as requirements elicitation, product analysis, and roadmapping. On the other hand, if a person takes on the role of a strategist, the person is more involved in the strategic and tactical parts of development and takes on activities such as customer communication, marketing, and product strategy. The leader has more authority than the strategist and has more influence on the resources for the product and finally, the problem solver focuses more on the activities related to the communication between different departments and stakeholders.

2.3.1 Software Product Management Frameworks

Over the years, various SPM frameworks have been developed [2]. Because the responsibilities within SPM can vary significantly across organizations due to differences in culture, products, and organizational structure, it can be challenging to precisely define the role within SPM [2]. The specific frameworks presented in this section have been mentioned in research from the systematic literature review conducted during this research.

There have been several frameworks introduced throughout the years and among these is the Reference Framework [2][29][31], which emphasizes the fundamental activities of a software product manager in product planning [2]. Other frameworks that have been produced are the Pragmatic marketing framework [2][28][31][32] and, an SPM framework created by Kittlaus and Clough [2][28][31]. The ISPMA SPM framework [2] is based on three different frameworks and is mentioned in various articles [2][31][32]. The Product Management Lifecycle Framework (ProdBoK) is mentioned in [32].

The Reference Framework [8] was proposed at the International Workshop on Software Product Management in 2006 and was a first attempt at bringing structure to SPM [2]. The framework is grounded in the software product and is structured hierarchically. It is based on four process areas within SPM: *Portfolio management, Product Roadmapping, Requirements Management, and Release Planning* and within these areas, there are main processes with different information flows [8]. This framework was created to suit the new challenges and opportunities that software brings such as frequent releases and complex requirements organization and is based on, among other things, the work of software product managers.

The Pragmatic Framework (or Pragmatic Marketing Framework) is a product management framework that helps product teams by providing a standard and a set of activities to ensure a profitable and competitive product [9]. Each of the activities presents responsibilities and actions that the team needs to handle. The main activities range from more strategy-focused to execution, and they are, in order, *market, focus, business, planning, programs, readiness,* and, *support*. The sub-activities within the previously presented main activities are the obligations inside SPM where the responsibilities and the skills required are listed.

Another framework is presented by Kittlaus and Clough in [33] and is inspired by the Pragmatic Framework. The areas where a software product manager is active are *Market Analysis, Product Analysis, Product Strategy, Product Planning, Development, Marketing, Sales and Distribution*, and *Support and Services*. The framework highlights both the core product management tasks and the core pricing functions because the authors believed that the business aspect of the field is vital and needs to be represented in the framework directly, unlike in the Reference Framework. This framework was also created to introduce an organization to SPM.

The International Software Product Management Association (ISPMA) SPM Framework is a structure that is continuously developed by the members of the ISPMA knowledge network [2]. The framework can be seen in Figure 2.2 and it can be used by an organization to build and enhance the discipline of SPM.

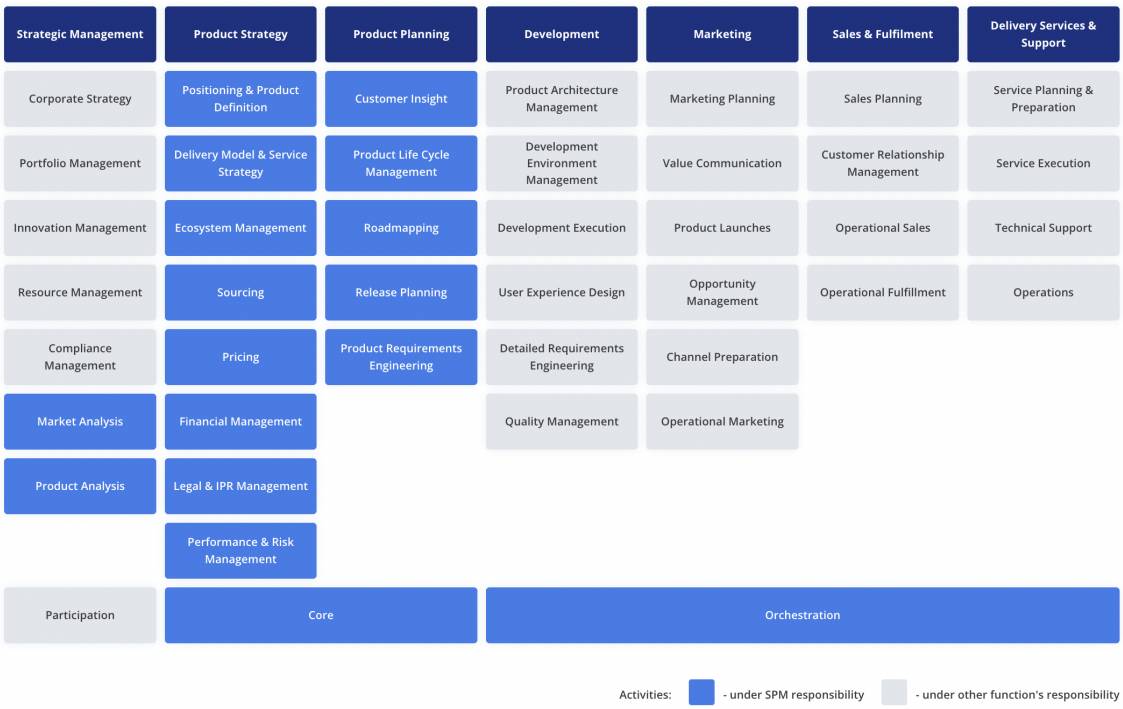

Figure 2.2: The ISPMA SPM Framework [2]

The framework is structured with the functional areas of a software organization in the columns whilst the rows within the columns follow a top-down approach,

starting from strategic and long-term objectives and cascading down to operational and short-term goals [2]. The "Core" columns (located at the bottom of the figure) denote the primary activities of a software product manager, for which the manager holds direct responsibility [2]. Activities listed in the "Participation" column involve the activities where the software product manager represents their product at the corporate level, while those in the "Orchestration" columns typically pertain to other organizational responsibilities. The task of a software product manager is also to make sure that all of these activities follow the product strategy they have established [2].

The Software Product Management Roles Framework (SPMRF) was presented in a study that aimed to understand and clarify the various roles of SPM and how they work and interact within an organization [23]. The research brought up four different roles that a software product manager tends to embrace: *the expert, the strategist, the leader, or the problem solver*. The presented roles were decided based on the framework that was created for practitioners and researchers to allow them to analyze the role of the product manager in the organization and be able to determine how the role can mature with new responsibilities. The different dimensions are categories based on the research conducted and these are the product manager's influence on the product, influence on collaborations, access to resources, and authority.

The Product Yield Potential Radar (PYPDR) is a framework that was constructed in [34] and is based on balancing the tough tasks and responsibilities within SPM. PYPDR is a framework that has structured the core parts of SPM into six different dimensions to be able to focus on product success. Each of the six dimensions introduces tasks and items that are critical for the product. To be able to use the framework to its full potential, four different steps are defined [34]. The first step involves understanding and defining the artifacts related to the product, in the second step, the roles should be clarified, the third step includes doing an assessment of the dimension items, and the fourth and final step includes analyzing the PYPR scores and prioritizing activities.

None of the frameworks mentioned in this section provides the field of SPM with a base knowledge of how to manage AI and ML components within products or how to use AI and ML tools to aid in various SPM activities. The products are changing and the field of SPM needs to change with them to ensure product success and customer satisfaction. The different frameworks presented are still relevant, however, AI and ML offer many new possibilities such as more data and faster feedback loops and they also introduce challenges that need to be warded. Therefore, a new SPM framework that focuses on targeting these differences to maximize the potential is necessary.

2.4 Related work

In this section, the related work to this thesis' research is presented. It involves articles and papers regarding AI and ML within the field of SPM.

2.4.1 Applying AI and ML within the field of SPM

SPM targets several activities that focus on different aspects of the development of the product and there has been research stating that AI and ML affect various of these [35].

Organizations need to make some changes when implementing AI models and data products. The implementation can lead to increased customer satisfaction, productivity by streamlined processes, and more informed and optimized decisions by discovering trends in data [35][36][37], as well as reduced costs [35][37]. By utilizing AI and ML, several activities within SPM can be enhanced and effectivized [38][39], and manual labor can be minimized.

To be able to utilize the advantages of AI and ML it is important to understand the users and their needs as well as make sure that the data collected is of quality to find relevant insights [36]. The collaboration between different roles within the organization is vital to creating and delivering products that meet customer needs. To utilize ChatGPT in product management and to ensure competitiveness and profits, companies should use generative AI [37]. They need to make sure that the model is trained according to its intended use, keep the model user-friendly, ensure that it integrates nicely with existing systems, and train the users of the model to produce the best results [37].

2.4.1.1 Using AI and ML in SPM activities

Within the ideation stage, where the concept of the product is produced, AI can be utilized to go through larger data sets to find patterns and insights and can also be used to generate many concepts in a shorter time, which can create unique ideas. AI can be used to gather a deeper understanding of the customer's behavior by finding latent insights about them in the data [35].

In market analysis, AI can only be of assistance [40], it can not replace the person within SPM who is performing the investigation, but it can help to save time during the analysis [41]. AI can be utilized in the market phase in the sense that data insights can give additional information regarding patterns, trends, and validation of ideas [35][40].

Other important activities in SPM are positioning and product definition and AI could help write features based on the data gathered in previous activities [41]. In customer insight and support, generative AI can help by basing answers on the requirements of the customer [41]. Product requirements engineering and detailed

requirements engineering are parts that can utilize generative AI by generating documentation [41].

The application of AI within prototyping is described as advantageous since it allows for faster iteration and optimization and within designing the user experience, AI can be used to analyze user data to personalize product experiences and ensure that the product satisfies the customer's needs [35]. AI can be used as a tool for ideas by creating several different variations of a design in the activity to design user experiences [41].

In development execution, AI is used to automate various tasks such as code generation and enhance capabilities through AI-driven features to increase productivity [35][40][41]. In the testing stage, AI can be utilized in generating text suites and improving the quality of the product [35].

AI can optimize the launch strategy of a product by creating engaging marketing campaigns and reducing costs [35]. Also, AI can be applied after launch and during maintenance of a product by, among other things, allowing for real-time data analysis [35]. AI can also help create a long-term vision and a strategy for the product [42].

2.4.1.2 AI-related frameworks in SPM

Traditional frameworks provide structured approaches to SPM but do not fully address the dynamic nature of modern digital ecosystems [38]. The proposed framework Strategic Digital Product Management in the Age of AI (SPM4AI,) aims to cover the gap that the traditional framework cannot close. It includes six approaches for realizing functionality based on stability and uncertainty to convert every identified situation [38]. The six approaches are requirements, creating data sets and models, exploratory development, retraining of models, experimentation, and reinforcement learning. The framework supports people in SPM in navigating the complexities of digital transformation, leveraging emerging technologies, and continuously adapting to changing customer needs and market trends.

Another framework that was presented is the comprehensive framework to manage AI and ML development and innovation within an organization [39]. The framework addresses various challenges and aims to streamline the process of integrating AI and ML technologies into business practices. It introduces the concept of an AI and ML product as a reusable algorithmic solution across multiple use cases. The framework balances mature and emerging business opportunities and aligns AI and ML product development with organizational goals. AI and ML development depend on two technology sets: DataOps and MLOps. DataOps supports data governance and preprocessing, while MLOps focuses on ML and deep learning practices.

2.4.2 Challenges with applying AI and ML in SPM

Many articles discussed the effects that AI and ML bear when integrating these technologies into SPM and because of the major changes that AI and ML bring to

all organizations and fields, various difficulties arise.

The traditional approach of collecting and specifying requirements at the start of development is increasingly insufficient [38]. It assumes that customer requirements can be identified upfront, which is often not the case in fast-changing environments. There is also a tension between developing features that cater to a large customer base and responding to specific, strategic customer needs [38]. Balancing exploration (developing new features) and exploitation (scaling and refining existing features) is challenging.

Integrating AI models with existing software systems is complex [39]. It requires automating the training and deployment pipeline and integrating model building with the rest of the software. AI models must also be adaptable to changing environments and data conditions [39]. This requires robust retraining and the ability to incorporate new data effectively.

The increased volumes of data make it challenging to build and automate models within software products [38][43]. High volumes of data require advanced computational resources and effective data management strategies. Another challenge is ensuring the quality of data which is critical for accurate predictions and insights [39][43]. Poor data quality can lead to unreliable models and error-prone results.

There could be negative ethical consequences with the application of generative AI [36][41]. AI product managers must ensure that AI is designed ethically, without unintended harmful effects and AI should be equitable, transparent, and reliable [42]. In regards to fairness, there is a risk of AI being biased because of the data on which it bases its decisions [41] and it is important to maintain user rights and trust [36]. Data privacy could be an issue because the AI needs an extensive amount of data to be able to perform well [36][41]. Someone has to be responsible for the results that the AI is producing, therefore accountability could be an issue and to ensure that the AI is performing well, it needs to be checked regularly to ensure robustness [41]. There are legal issues with utilizing AI because contracts and privacy protections need to be updated to ensure clarity regarding usage. AI product managers must address ethical concerns, ensure transparency in AI decisions, and maintain high performance and reliability through continuous monitoring [42].

3
Research method

In this section, the different methods used for conducting this master's thesis are presented. Each method used is defined and backed up by relevant information and the application on this project is described. The methods presented aimed to answer the thesis' research questions as well as assist in empirically deriving the software product management framework. In Figure 3.1 the outline for this thesis' research method is presented.

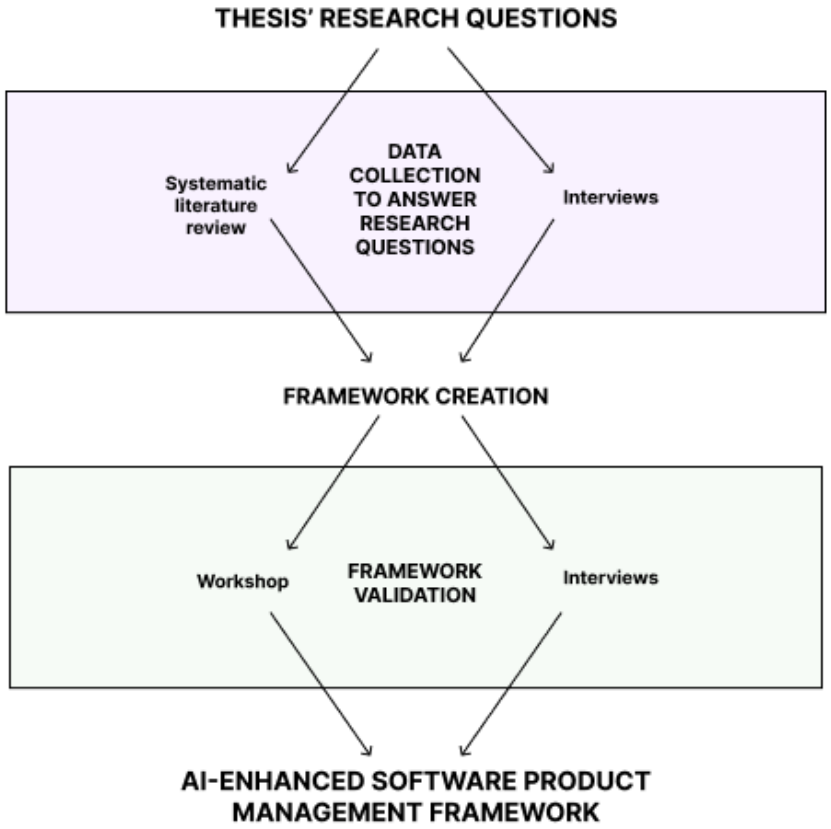

Figure 3.1: Research method outline

Based on the created research questions for this thesis, a systematic literature review (SLR) and interviews with practitioners of the field were done to gather data to answer them. The data that was collected was used to empirically derive an SPM

framework. The goal was to acknowledge the challenges that AI and ML bring to the field as well as provide guidelines for individuals within SPM and organizations on how to implement these technologies. This framework was validated by conducting a workshop and an interview. The information from the validation activities contributed to the creation of the finalized AI-Enhanced Software Product Management Framework.

3.1 Data collection

The data collection is the foundation for this thesis since the goal is to gather data on the topics of digital transformation, SPM, AI, and ML. This is to be able to empirically construct an SPM framework that can support the field of SPM by addressing the changes that AI and ML components and tools bring.

3.1.1 Systematic Literature Review

A SLR was conducted to find research to help answer the thesis' research questions and later support the creation of the SPM framework. The framework is derived empirically and one of the pillars is the information identified by the SLR.

The format of the review is inspired by the article "Guidelines for performing Systematic Literature Reviews in Software Engineering" by Barbara Kitchenham [44] which presents general guidelines for conducting an SLR. The guidelines are aimed at people conducting software engineering research and are derived from the original purpose for performing SLRs, to support evidence-based medicine.

The purpose of conducting an SLR is to acquire available information on a specific topic from specific questions. By doing it systematically it is ensured that the review is done thoroughly and fairly [44]. It is also less likely to introduce bias if the literature review is done systematically. However, doing an SLR takes more time and effort than doing a literature review and since it is only one component of this thesis, some adjustments were made. One change made was that the protocol was evaluated during two iterations instead of an extensive amount to make sure that the SLR did not take an exaggerated amount of time.

There are three main phases for doing an SLR: Planning the review, conducting the review, and reporting the review [44]. In the first phase, the researchers identify the need for a review, construct the questions specific to the SLR, and develop the protocol. In the second phase, the researchers find the research articles and perform data extraction, and in the third phase, the researchers report the review by formatting and evaluating the report.

To start the first phase, the need for the SLR was identified. The objective of the review was defined as identifying the research gap in the realm of AI and ML components and tools utilization in SPM. It aimed to uncover existing research on how AI and ML contribute to digital transformation and digitalization and the challenges

that the technologies bring. It also aimed to understand the core activities within SPM and the different agile frameworks that the field needs to adapt to.

After identifying the need for conducting an SLR, the questions for this specific SLR were composed and these are presented in the list below.

- **SLR-Q1:** How are AI and ML currently being utilized to drive digitalization?
  - SLR-Q1.1: What are the various applications and use cases with AI and ML?
  - SLR-Q1.2: What are the challenges when applying/using AI and ML in companies?
- **SLR-Q2:** What are the primary responsibilities and functions in the role within software product management?
  - SLR-Q2.1: What are the major challenges faced in SPM, and how are they typically addressed?
  - SLR-Q2.2: What methodologies must software product management adapt their work to?

There are two main questions and subquestions to them. These questions are different from the research questions for the thesis. This is because the goal of conducting the SLR was to gather information on the current status of AI and ML as drivers for digital transformation and digitalization, and the main responsibilities within SPM to help understand how it works today and how an SPM framework can be created to suit this environment.

The questions for the SLR were constructed to get a broad understanding of how AI and ML are generally used to drive digitalization, what the technologies' use cases are as well as getting a vast knowledge about SPM. Research that focused on AI and ML within SPM was presented in the related work, in section 2.4, since most of the papers were published after the conduction of the SLR.

The questions presented in the list above aim to help accomplish the presented goals for the SLR and are the base for the construction of the protocol. From these questions, five different search equations were derived which can be seen in the protocol in Appendix A.1.

3.1.1.1 Systematic literature review protocol

To conduct an SLR, a protocol is created that presents a search strategy to guide the review [44]. A protocol is developed to decrease the risk of introducing possible bias into the review. The protocol consists of the scope of the review and the questions that have been constructed already but it also includes sections on the search strategy, the search terms, the study's selection criteria, selection procedures, quality assessment checklists, data extraction strategy, synthesis strategy, dissemination strategy, and project timetable as presented in [44]. The quality assessment checklists are inspired by the quality checklists presented for the different types of studies

in [44].

The SLR protocol that was created can be found in its whole in Appendix A.1.

3.1.1.2 Conduction of the systematic literature review

As presented in the protocol that was created, five different databases were searched to acquire research on the topics. ACM Digital Library, IEEExplore, Google Scholar, Scopus, and ScienceDirect. The questions created for the SLR were broken down and keywords were identified that could be used in the search terms for the databases. The different databases required diverse search equations to find the matching research.

3.1.1.3 Evaluation iterations

The first iteration gathered all articles that had titles that matched the specific search terms. Any duplications that were found during the first iteration were removed. In the second iteration, the screening, research that did not match the stated search criteria was removed. In the third iteration, retrieval, all the research that was relevant for this specific thesis moved on to the final step whilst research within fields not relevant for this thesis was removed. In the final iteration, the research went through a checking based on a quality assessment checklist shown in the protocol, where all research received a score between 0 and 1, and those that scored 0.60 or above advanced to the final set of literature.

3.1.1.4 Data collection and extraction

Data collection when doing SLRs is done in order to gather relevant information from the research that was selected [44]. To address the questions that were created for the SLR, a data collection form needs to be created.

The data collection form was assembled by adding basic questions about the research's title and publication details as well as how many countries and companies the research was done in. The main part of the form consisted of questions based on the review questions and their sub-questions. Due to lack of time, all research was independently data extracted by one researcher.

The data collection form can be seen in its whole in Appendix A.2.

3.1.2 Interviews

Interviews were selected as the complementing approach to the SLR to answer the thesis' research questions. Interviews were chosen because they allow the researchers to gather information regarding the thesis research questions from practitioners within the field. This method also helps to connect and identify similarities and differences in information from the SLR.

Interviews were conducted to gather pertinent data regarding the experiences of people within SPM when working with products containing AI and ML components and when utilizing AI and ML tools. The interviews conducted were structured with guidance from the paper "Guidelines for conducting and reporting case study research in software engineering" by Per Runeson and Martin Höst [45]. There are different types of interviews, structured, semi-structured, and unstructured, and they can contain both open and closed questions. A semi-structured interview format with both open and closed questions was constructed to allow the interviewees to be able to speak freely about their experiences and thoughts but also make sure that relevant data for the thesis could be gathered.

Several different interviews were conducted with people within SPM from different companies within the Software Center organization, from companies that connected with the authors through LinkedIn, or other contacts. In Table 3.1, the roles and the dates of the interviews conducted can be seen.

Table 3.1: The interviews conducted

Interview No.	*Company*	*Interviewee's role*	*Date*
1	Company A	Lead Architect	2024-02-15
2	Company B	Product manager	2024-02-20
3	Company C	Senior manager	2024-02-21
4	Company D	Product manager	2024-02-21
5	Company E	Data Scientist	2024-02-22
6	Company F	Team leader and Product Manager	2024-02-22
7	Company F	Product manager	2024-02-28
8	Company G	Group manager	2024-03-01
9	Company H	Director of product	2024-03-04
10	Company I	Head of analytics	2024-03-07
11	Company J	Line manager	2024-03-08
12	Company A	Program manager, Area product owner *	2024-03-08
13	Company K	Staff software engineer	2024-03-12
14	Company L	Business process development manager	2024-03-13
15	Company M	Cheif Information Officer	2024-03-19
16	Company N	Director of Business IT	2024-03-19

**This interview was conducted with two different persons from the same company.*

The interviewees all came from well-established organizations that are active within various areas ranging from automotive to energy and the sizes of the companies ranged from a few hundred employees to 100.000. The interviewees had years of experience varying from just a few years to over ten years.

3.1.2.1 Interview Guide

An interview guide is a tool that is used to guide an interview in a specific direction and it allows the interviewers to have a guideline to resort to during the interview.

An interview can be constructed with different phases, for example with one phase for the introductory questions and another for the main questions of the interview. The interview guide was created with five different phases. The first one was an introduction phase where the interviewer presented the objective of the interview and asked if recording and transcribing the interview was approved. The second phase consisted of introductory questions that transitioned into the third phase, the main questions. The fourth phase was composed of ending questions to make sure that the interviewees felt like they were able to mention everything they wanted and finally, the fifth phase included thanking the interviewee for their time.

The interview guide can be found in its whole in Appendix A.3.

3.1.2.2 Pilot interview

Pilot interviews can be used to test the constructed interview guide to avoid making mistakes during the interview and to be able to adjust the structure and questions of the interview to ensure that the interview afterward becomes as good as possible. A pilot interview was conducted for these reasons and after the pilot interview, a few changes were made to the interview guide. Some questions were deleted, others were merged and a few structural changes were made. The pilot interview was conducted with a person with the role of head of customer support manager at Company A.

3.2 Data analysis

Performing data analysis is important to understand what the data that has been gathered indicates and to be able to investigate various themes and topics. Qualitative data are descriptive, non-numerical, data and are often collected through interviews and observations [45]. There are different methods for analyzing and interpreting qualitative data to extract patterns and themes from it.

3.2.1 Thematic analysis

Thematic analysis is a method and technique used to investigate and explore qualitative data to extract themes and patterns from it [46]. One of the advantages of thematic analysis is its flexibility and the method aims to describe and organize the data set in a minimal way to present rich details. The goal is, as previously stated, to identify themes in a data set, and a theme is defined in [46] as a part that has acquired something important in the data about the specific research questions. The theme also represents a meaning or a pattern from within the data set. There is no set number of instances that something has to show up within a data set for it to be considered a theme. Thematic analysis is a qualitative analysis which means that the themes depend on the data set that is analyzed and the researcher can apply their judgment and focus more on how the theme concerning the research question.

The researchers aimed to provide thematic descriptions for the entire data set from the interviews and therefore the themes are an accurate reflection of the findings.

Braun and Clarke present two ways to perform thematic analysis [46], inductively and theoretically. An inductive approach presents themes that are heavily connected to the data set whilst the theoretical approach focuses more on the researcher's interest in the data and the aspects that the researcher wants to focus on. Since the goal of the interviews was to assist the SLR in answering the research questions by exploring industrial practitioners' experiences, a theoretical thematic analysis was chosen.

According to [46], there are two ways of deciding the themes during the analysis. The semantic level refers to themes that only explicitly exist in the data and no further analyses are done to go deeper into the meaning of the themes. The latent level allows for deeper analysis, to go further than what is written to be able to find underlying themes. The choice for this research was to use the latent level to determine the themes. This was because the research aimed to answer specific research questions and the interview guide had been developed to be able to answer those. Because of this, the data from the interviews were based on underlying themes that had been thought about beforehand.

There are six different steps to conducting a thematic analysis [46]. The first step is *Familirizing yourself with the data* and is done to be able to understand the data's depth and breadth. This was done by reading through the transcriptions from the interviews and cleaning up the texts by adjusting grammatical errors such as typos. During the cleaning of the notes, some first comments were made to start the analysis. These comments could for example be interesting quotes that related to the research questions such as: *To look into data and see what secrets hide in this data.*

The second phase, *Generating initial codes* aims to develop the first and most basic features that were found in the data set. There are two different approaches to coding based on the types of themes. Data-driven themes depend on the data whilst theory-driven themes are developed with certain aspects in mind. The themes within this thesis were theory-driven and were based on the questions that were asked during the interviews therefore during coding, the codes produced were affected by the themes. However, all relevant data were coded to ensure that all information was considered. The codes that were generated came from going over the transcriptions of the interviews again and looking at the initial comments. Codes such as analyzing data, hidden insights, replacing boring tasks, and aiding in decision-making were created to guide the creation of themes.

Searching for themes is the third step and the goal is to sort the codes produced in the previous step into themes. This was done by analyzing the different codes and making sure that themes that suited the code were developed and that a lot of the codes were suited to fit into the themes that were considered before the thematic analysis started. An example of a decision to create a theme was that codes such as too little quality data, data gathering, interpret data, and data handling led to the theme Data. The initial thematic map over the themes can be found in Appendix A.4.

The fourth step is *Reviewing themes* and this phase focuses on considering the themes that were constructed in the previous step where some themes might be removed, some merged and others broken down into smaller themes. In this step, the researchers check that the themes that they have constructed are connected to the dataset and also ensure that all data has been missed in previous phases into themes. Some themes were removed and some merged. For example, the themes Productivity and Efficiency were merged into the new theme Efficiency because both of the original themes focused on the same thing. The themes were checked with the data from the interviews and it was ensured that all the data were placed into themes. The revised thematic map after the fourth step can be found in Appendix A.5.

The fifth step, *Defining and naming themes* is done to further refine the constructed themes and to ensure that they are not too big or complex and that they are related to the data. In this phase, descriptions of the themes are written down to ensure that it is clear what the themes are and what they are not. This step was done by going over the themes that were constructed and ensuring that both researchers were satisfied with what data the various themes represented and to ensure that they were not too big which could lead to loss of details. *Producing the report*, is the sixth and final step in thematic analysis. The goal is to write a report that provides the reader with enough information, details, and data to back up the analysis' validity and the themes presented.

3.3 Framework validation

To be able to validate the empirically derived framework, two different approaches were taken. The first approach was to construct a workshop for people within SPM to present the created framework and retrieve feedback in the process for later iterations of the framework. The second approach was to schedule interviews with people who could not attend the workshop.

3.3.1 Workshop

To validate the created framework and to receive feedback from people within the industry, an online workshop was organized. The workshop was conducted on the 3rd of May 2024 and lasted for roughly two hours. Participants in the workshop were both people who had been interviewed in the earlier phase of the project and some new people had been found through the old interviewee's contacts and LinkedIn. A list of the people who partook in the workshop is shown in Table 3.2.

Table 3.2: The participants in the validation workshop

Participant No.	*Company*	*Participant's role*	*Interviewee/New*
1	Company A	Lead Architect	Interviewee
2	Company C	Senior manager	Interviewee
3	Company D	Product manager	Interviewee
4	Company F	Team leader and Product Manager	Interviewee
5	Company F	Product manager	Interviewee
6	Company G	Group manager	Interviewee
7	Company C	Chief Software Architect	New
8	Company C	Digital Business Development and Global Program Development Manager	New
9	Company F	Product Specialist	New
10	Company F	Integrated Design Specialist	New

The workshop started with a small introduction of everyone and then the first created framework and the first created perspectives were presented. After the presentation, the participants got to ask any questions they had regarding the framework before the discussions began. They got five minutes of reflection to think through the questions that were asked about how the framework could be improved. Then they got split into two breakout rooms which is where the discussions began. They got to discuss the same questions that they had reflected on earlier and later they got to come up with solutions to the problems or improvements that they discussed. During the solution phase, the participants used a tool called Miro, which is a tool that can be used online to draw, write notes, etc. together with others. This was used for them to construct their solutions to the problems they had previously discussed. The next phase was a full discussion with everyone back from the breakout rooms to discuss what each group had talked about and which solutions they had come up with. The last phase was a final reflection to see if they had found the workshop and framework successful and to round up the discussion.

The workshop guide that was created for the workshop can be found in its whole in Appendix A.6.

3.3.2 Interviews

Since not everyone who wanted to participate in the workshop was able to attend during the scheduled meeting, there was a possibility to participate in an interview to give feedback about the framework. An interview guide was created for the interview and this guide was based on the workshop guide found in Appendix A.6. The interview conducted can be seen in Table 3.3.

Table 3.3: The participant in the validation interview

Interview No.	*Company*	*Participant's role*	*Interviewee/New*
1	Company I	Head of analytics	Interviewee

The guide that was created for the interview can be found in its whole in Appendix A.7.

4
Results

This section presents the results from the data collection described in Chapter 3 and analyzes the results. All of the tables are based on the data gathered in the various data collection approaches. The results are presented in chronological order, with the SLR first, the interviews second, and finally, the answers to the thesis research questions.

4.1 Systematic Literature Review

Five different databases were searched: ACM Digital Library, Google Scholar, IEEEXplore, ScienceDirect, and Scopus. As presented in Chapter 3, different iterations were done to riddle out research not relevant or that lacked quality. Below are five different tables, one for each database searched where the rows represent the results from the different search equations and the columns show the resulting amount of papers per iteration done. The search equations are shown in the SLR protocol in Appendix A.1.

In Table 4.1 the result from the different search equations during the various iterations for the SLR for the database ACM is seen. In the last three equations, no article was found to match and in search equations (SE) two and three, very few articles were found. After all the iterations, only one research paper from SE3 was approved for use.

Table 4.1: Result from the systematic literature review - ACM

Search equation	*Total*	*Screened*	*Retrieved*	*Eligible*	*Quality checked*
$SE1$	87	67	1	0	0
$SE2$	4	0	0	0	0
$SE3$	2	1	1	1	1
$SE4$	0	0	0	0	0
$SE5$	0	0	0	0	0

Google Scholar was the second database to be searched and the results are shown in Table 4.2. Since Google Scholar contains many research papers from other databases, the SE for this database found numerous matches. As can be seen, there are fewer matches in the last three search equations, similar to the results from ACM. Finally, seven different articles were selected after quality assessments.

Table 4.2: Result from the systematic literature review - Google Scholar

Search equation	*Total*	*Screened*	*Retrieved*	*Eligible*	*Quality checked*
$SE1$	827	268	25	15	5
$SE2$	47	19	0	0	0
$SE3$	52	13	3	2	1
$SE4$	14	9	2	1	0
$SE5$	10	9	1	0	0

The third database searched was IEEEXplore and the results are shown in Table 4.3. The results follow the same pattern as for the previous databases in many senses except that SE two did not find any articles. The total amount of research papers that were selected from IEEEXplore was six.

Table 4.3: Result from the systematic literature review - IEEEXplore

Search equation	*Total*	*Screened*	*Retrieved*	*Eligible*	*Quality checked*
$SE1$	35	32	5	4	2
$SE2$	0	0	0	0	0
$SE3$	16	7	1	1	1
$SE4$	3	2	0	0	0
$SE5$	5	5	3	3	3

As can be seen in Table 4.4, the results from the different SE within ScienceDirect follow the same pattern as the previously searched databases, and in total, five different articles were selected from the database.

Table 4.4: Result from the systematic literature review - ScienceDirect

Search equation	*Total*	*Screened*	*Retrieved*	*Eligible*	*Quality checked*
$SE1$	287	114	7	5	3
$SE2$	14	2	0	0	0
$SE3$	2	2	1	1	1
$SE4$	2	2	1	1	1
$SE5$	1	1	0	0	0

The final database searched was Scopus and once again, the same pattern applied to this database. In general, there was a decreasing amount of papers found in the last search equation compared to the first one. The final amount of papers selected from Scopus was eight.

Table 4.5: Result from the systematic literature review - Scopus

Search equation	*Total*	*Screened*	*Retrieved*	*Eligible*	*Quality checked*
$SE1$	275	154	21	5	5
$SE2$	54	14	1	0	0
$SE3$	27	11	7	0	0
$SE4$	7	6	3	2	2
$SE5$	7	2	2	2	1

From this SLR, the total number of papers saved in all the databases searched was 27. From SE1, 15 research papers were selected. From SE2 no research papers were selected. From SE3, four articles were selected. From SE4, three research papers were selected. Finally, from SE5, four papers were selected.

The data extraction from the SLR resulted in a comprehensive base of knowledge about SPM, AI, and ML as drivers for digital transformation and digitalization, as well as the current research on using AI within SPM The data extraction was based on the questions from the SLR.

4.1.1 Data extraction of literature

In this section, the knowledge gathered from the SLR will be presented based on the questions that are presented in the SLR protocol in Appendix A.1. The results of the subquestions will be presented under their main questions.

4.1.1.1 SLR-Q1: Artificial intelligence and machine learning as drivers of digitalization within companies

In the rapidly evolving landscape of digitalization, companies are increasingly relying on AI to manage the complexities and high demands of modern business environments [1][3][15][47][48][49]. Companies are under constant pressure to remodel their business operations and models [50]. They need to invest time and resources into AI and ML to stay competitive [16]. However, it differs for companies. One difference is when it comes to small and medium-sized enterprises. Because of the difference in size, they may need to make more of an effort as opposed to larger organizations [51].

The identified drivers for digitalization are being able to make decisions based on data [16][48][49][52][53] and automation which means that they can create automated processes, for example, testing, data analysis, and feature engineering [49][53]. Another driver is less human labor which gives employees more time to focus on creativity and strategic tasks [16][49][53]. Efficiency and productivity are other drivers for implementing AI and ML in digital transformation and digitalization[11][48] as well as enhanced security which means that AI can help detect faults or errors within the products [11][48]. Customer satisfaction is also a major motivation for AI because it can analyze the behavior of the customer and make suggestions based on the analysis. Other drivers are technological advancement, competitive advantage,

consistency, enhanced quality of processes and products, and cost-saving [48].

The key factors for implementing AI and ML successfully are ensuring that the organization has good leadership that supports and understands the necessity of implementing AI and ML as a part of digital transformation and digitalization [31][49][54]. A company needs to ensure a culture within the company that supports change [31][49][54]. They also need to look at the amount of data that they have to ensure that they have enough to build AI and ML tools upon [11][52][53]. It is important to have processes that ensure data quality and accessibility, allowing the right individuals access to appropriate data. Additionally, data governance is essential for establishing policies, standards, and procedures [31][49]. Another important key factor is an organization's adaptability to new technologies [11][54]. The last key factors that were identified are investment, getting support from technical partners [54], and knowledge about AI and ML [11]. Failure to adopt AI in digitalization strategies can result in financial losses, slower innovation, outdated technological systems, and a decline in competitive edge [15].

SLR-Q1.1. There were several identified use cases for AI and ML, some are high-level and some are low-level. The first and most mentioned one is that AI and ML can be used for strategic decision-making [16][49][52][53]. Using data to make decisions about roadmaps, long-term visions, and product predictions is a defined benefit for AI and ML [49][50]. Given the vast amount of data that can be overwhelming for humans to process and analyze, smart technologies like AI and ML are invaluable. AI and ML can help or even replace humans in this regard. Then there are use cases where activities such as quality assurance and testing, feature engineering, and calculating the return of investment and value measurements can be aided by AI and ML [49].

AI and ML can enhance the customer experience by analyzing their behavior and usage of products. The technologies can suggest new features or features that can be removed [49]. Another use case of AI and ML is to use them as a service in products for customer usage, for example, Microsoft Teams uses AI as a service in their product to transcribe meetings [50]. Then lastly there are use cases for using AI together with other technologies such as robotics [50].

SLR-Q1.2. Two of the most frequently mentioned challenges with implementing AI and ML into the digital transition process are lack of leadership and management [15][47][54], and the culture changes AI brings to an organization [15][16][47][54]. Challenges arise when leadership and management do not have commitment or sufficient knowledge about AI and ML. Cultural changes are about employees being resistant to change. Lack of skill is another challenge that organizations face with AI and ML [47][55][56]. Organizations need to train their employees and hire new talent who possess knowledge about these new technologies. Integrating new technologies such as AI and ML can be a struggle if the existing systems are not adaptable to change [47][54][55].

AI is known as a black box and can be hard to understand at times [15][16]. To fix this, organizations need to train their employees on how AI works, specifically regarding their own AI tools. AI can also be a potential security risk, especially if organizations are using other tools than their own since they do not know how their data is being used [47][54]. The solution is to build their own tool or ensure that the tools they use do not share company secrets with other parties. Another challenge is the lack of sufficient funding or lack of resources, which makes it hard to invest in AI and ML [47][54]. The two last challenges are problems with the fairness of AI and the potential of biases [57], and that it is hard to find use cases for AI within companies [47].

4.1.1.2 SLR-Q2: Primary responsibilities and functions in the role of software product management

SPM frameworks bring up many similar SPM activities but there are some differences between the presented core activities. In comparison with other core activities that have been presented in different frameworks, the Reference SPM framework [8], SPM processes [58], Pragmatic marketing framework [9], and the ISPMA SPM Framework [2], roadmapping and product requirements engineering are present in all sets of core activities and there are also some overlaps with the other activities. Some of the most mentioned activities in the SLR are presented below.

Roadmapping. Roadmapping, which is mentioned in [2][23][27][28][32][59], is an activity that focuses on the delivery over a longer time and describes what the company will achieve over that time. A roadmap is a plan for the processes based on the product strategy and contains the actions, steps, and resources that are needed to accomplish the goals.

Product requirements engineering. The process of discovering the wants and needs of the different stakeholders is called *Requirements engineering* and is one of the core activities within the field of SPM [2][24][27][32][59][60][61]. It is done to be able to check that the created product meets the set requirements and contains a broad set of activities such as elicitation, specification, and validation.

Release management. SPM involves *Release management* or *Release planning* which is the activity of prioritizing requirements and planning for the upcoming release of the product [2][23][24][26][27][28][32][59][60][61]. The goal is to plan one or more releases along the lines of the business objectives to ensure that they are met.

Product portfolio management. Product portfolio management is a core activity within SPM [25][26][27][59][61] that focuses on looking at how the products are performing and seeing how they align with the goals that are set for them. This activity also regards identifying opportunities and risks as well as optimizing resources and focuses on solving a market problem.

Market strategy. The market strategy [23][25][26][32] is important because it is vital to understand what the market looks like. It is essential to understand what needs to be developed, what works, and what does not work, in order to understand the company's ability to contribute to the market. A strategy for accomplishing economic success by understanding the market is important within SPM.

Product strategy. Product strategy is another activity necessary for SPM [32][61]. The core activity provides the details on how to implement a product vision and SPM is responsible for keeping this strategy updated.

Product lifecycle management. Product lifecycle management [24][27] changes the present focus of product management since SPM is responsible for the entire lifecycle of the product. Different phases of the product require a different focus, for example, the first stage where the product is determined requires more experimentation.

SPM is responsible for more activities than the core ones presented in this section, however, other activities are under other functions' responsibility [2].

SLR-Q2.1. SPM faces several different challenges and the practice of SPM is extensive since it regards both the business aspects of a product as well as the technical aspects. The article [32] presents 27 diverse problems that SPM faces that were discovered during the research. The various problems that were given had a wide scope which indicates that the field of SPM is broad and that there are problems that arise in all different areas. The article discusses the five most common problems in more detail and these are presented below.

Determining the true value of the product that the customer needs was the most frequent problem found in [32]. Determining the true value requires deep research and it affects the entire lifecycle of the product. This is a demanding process to be able to understand the needs of the customer [25]. Understanding the needs also affects the profits of the product since how well the product suits the customer will decide whether they buy it or not [32].

Strategy and priorities are changing frequently is the second most common problem and arises because the strategy is constantly changing due to changes in customer requirements and market needs. This affects SPM since it needs to re-prioritize often and struggles to see a clear direction [25]. SPM has responsibilities within several different teams and departments and therefore it can be hard to change the direction for all of those teams when the new priorities come [32].

Technical debt. The third most common problem, *technical debt*, slows down the process of development and it can be difficult to know if it is a problem that needs to be solved or if the risk is worth accepting. This is a problem that

relates to the technical aspect of SPM and the person responsible for it [32]. If technical debt slows down development, the product's progression to production and release to the customer is delayed.

Working in silos. The fourth most common problem derived was *Working in silos (problem with communication, synchronization between teams).* It emerges because several different teams, across different departments, need to be aligned towards common goals and the person working with SPM needs to ensure good communication which can be a tough task to handle [32].

Balancing between reactive and proactive work. The fifth, and final, most common problem presented was *Balancing between reactive and proactive work* and it appears because it can be hard to balance the decision between focusing on innovation or maintenance. Innovation can mean finding new ideas to create value for the customer whilst maintaining regards tasks such as bug fixing [25].

The article [27] presents an additional challenge that SPM faces.

Size of the company. SPM faces challenges related to the size of the company. Since larger companies tend to have more resources the focus on the different activities within the field can vary depending on the size [27]. Therefore, the execution of SPM can look different between companies and it needs to adapt accordingly. Activities that were found to be roughly the same between different-sized companies were development, lifecycle management, business analysis, product requirements, and sales. Activities that differed between large enterprises and small to medium enterprises were marketing, release planning, roadmapping, and strategic and tactical planning.

One final challenge that SPM faces is mentioned in [23].

Large responsibility for one person. The field of SPM is extensive with activities that spread to everything from business to technical aspects of the product. Therefore it can be a tough job for a single person to take responsibility for all of these tasks alone. This can lead to difficulties in trying to understand and track the process of SPM within an organization.

SLR-Q2.2. The agile methodology has become a popular knowledge to ground an organization's workflow and processes [24] and several different frameworks have been established with the Agile Manifesto as a base. Some of the frameworks that have been integrated into the industry are SCRUM [24][32] and Lean [28].

In [24] the authors introduce a method that allows organizations to apply the Scrum principles to SPM. Because agile principles are successful in several different cases, there has been a wish to be able to apply the method to other disciplines such as SPM. During a case study where the developed method was applied, several different findings were presented as a result. The different lessons learned were: *Alternat-*

ing cycles for SPM and Development, Daily SCRUM meetings are essential, Large requirements are in need of structured detailing, Backlog administration requires discipline, and Early collaboration promotes reuse and integration.

It is common to assume that the role of the Product Owner is the same as the Product Manager and that they have similar responsibilities, which partially is true. However, the two roles have several differences. The responsibility of the product owner is to serve as the outside connection for the development team and when trying to map the activities that the product owner is responsible for there are several of them that relate to activities within SPM [62]. Some companies combine these two roles and to be able to utilize the advantages of having both, the company needs to make sure that the obligations between them are clearly stated to avoid confusion [62]. Often, the more technical part of product development is the responsibility of the product owner whilst the more business-focused activities become the responsibility of the product manager.

According to another research article, [32], SPM is similar to the Agile and Lean principles in the sense that all methodologies focus on the fast delivery of products to market for business value. However, the practice of SPM extends to activities across both the technical and business perspectives where others might be lacking. Scrum, which is an agile technique, supports SPM as a framework because Scrum supports the repeated process of working towards improving the product and the team [32]. One of the problems that were presented in the research was that *"Teams are not Agile, they just follow rules and do not use experimentation and a learning process"*, which was a concluded problem from interviews with practitioners. The problem was constructed from product managers mentioning that they had struggles with, for example, people not understanding what agile means and losing focus of the bigger picture and the long-term goals.

Lean principles, unlike the Scrum principles, focus on reducing waste to increase value [28]. Five different principles regard the Lean philosophy and they are Value, Value Stream, Flow, Pull, and Perfection. [28] focuses on creating a perspective on SPM from Lean principles and displays five problems that SPM faces that Lean solutions can help to address. First of all, Lean solutions can help the long release cycles by using flow to decrease time to market by making the development process more predictable and letting marketing start its work earlier. The second problem stated was that there were no metrics for evaluating the work. By using value to identify key performance indicators, which according to Lean principles are important, product managers can help the performance of the team and the success of the product. *Collaboration between Organizations and Customers* is the third problem and Lean principles suggest solving this problem by *Using Pull to Develop Product Faster and with Fewer Resources*. Working with the customer from the beginning saves the company time and will decrease the product's time to market. The fourth problem presented was *Short-Term Thinking* and the Lean solution to this issue is *Using Perfection to Adopt Long-Term Thinking*. Instead of focusing on implementing the trending processes, long-term thinking helps the company to, among

other things, increase efficiency and reduce costs. The fifth, and final problem, was *Trying to Change Instantly*. The Lean solution is presented as *Using Perfection for Incremental Changes* which means that organizations should prefer small changes to be able to identify problems early.

4.2 Interviews

The semi-structured interviews generated a lot of qualitative data and a total of 16 interviews were conducted. The number of companies that were part of the interview was 14.

4.2.1 Thematic analysis

After going through the five steps for the thematic analysis that was presented in Chapter 3, it was time for the final step, *Producing the Report*. Figure 4.1 is the final representation of the themes identified through the data gathered from the interviews. It displays the main themes and the corresponding sub-themes that were identified during the analysis.

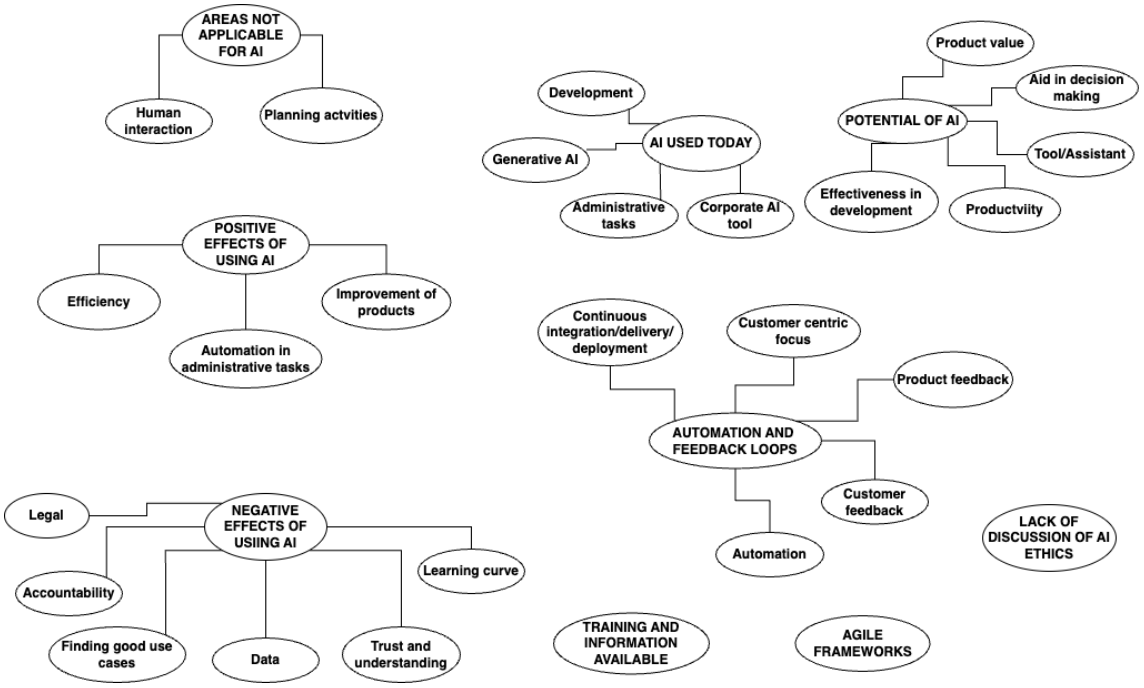

Figure 4.1: Final thematic map over themes from the interviews

One of the main themes that were identified was *Areas not applicable for AI* which was broken down further into two sub-categories. It is about areas within SPM that the interviewees could not see being replaced by AI or ML. The first sub-theme is *Human interactions* and was identified from several codes, such as negotiating and team activities. Negotiating comes from five interviewees who mentioned that

negotiating with stakeholders and customers regarding products and features and building a relationship with them is something AI and ML cannot replace. Team activities is another code that led to the sub-theme, which came from three interviews mentioning that they did not see how AI and ML could do performance interviews on employees or give them the motivation they need. The other sub-theme, *Planning activites*, was gathered from the codes' long-term vision and launch strategy, which reflected what two interviewees said about the complexity of the tasks, which they thought that an AI or ML tool could not do.

Positive effects of using AI is another main theme that was identified during the analysis of the interviews and is about the success factors and positive effects that AI and ML have or could potentially have on SPM. It was divided into three subcategories. *Efficiency* is the first sub-theme and comes from the following codes: saving time, working around the clock, and productivity. Saving time comes from three interviewees saying they can write faster and cleaner with AI assistance, which saves time. One person also mentioned that AI does not take breaks and can work 24 hours a day, every day of the week, which is where the code, work around the clock, came from. Productivity came from eleven of the interviewees who mentioned that AI can help speed up various tasks. The second sub-theme is *Automation in administrative tasks* and was made from the codes administrative tasks and automation of repetitive tasks, which came from four people mentioning that they see great potential in using AI and ML tools to help and automate routine tasks, such as writing texts. The last sub-theme *Improvment of products* was identified through the codes features and improvement of products. Five interviewees mentioned that they see the potential of AI and ML to improve products by identifying unnecessary features and understanding what features to improve.

Another main theme is *Negative effects of using AI* which is regarding all the challenges and negative effects that the interviewees have experienced or believed that they will experience with AI and ML. It has six identified sub-themes. The first sub-theme is *Legal* and was identified through two codes: intellectual property rights (IPR) and legal problems with AI. Three interviewees mentioned IPR and two mentioned more in general the legal problems that could come from using AI and ML. Both stem from the legal point of view of who owns what an AI produces. It gets especially difficult when an AI decision or work of an AI is made by an open-source platform because then there is an additional risk of leaking company information. The second sub-theme is *Accountability* and came from the code accountability and responsibility. Two interviewees talked about their concerns about who is responsible or should be held accountable for what the AI produces and helps with. The next sub-theme *Finding good use cases* came from the codes no use case and potential use case that arose from eight people who saw the potential of AI but had not found the right use cases for it yet. *Data*, another sub-theme, was identified by the following codes: data collection, data quality, and data management. Data collection, which came from four interviewees, is regarding the gathering of the data and what data points should be looked at. Data quality, which came from three interviewees, is about ensuring that the collected data is of good quality for the AI

to make well-informed decisions or take good actions. Data management, which also came from three interviewees, is how to store and utilize the data. The next sub-theme is *Trust and understanding*, identified by the codes trust and understanding. Thirteen interviewees mentioned that it is hard to trust AI when you do not know how to use it. Most people do not understand what is behind or inside the AI tool, making them reluctant to trust its judgment. The last sub-theme is *Learning curve* and is about learning how to use an AI and understanding that a new skill set is required when dealing with new techniques, such as AI and ML in SPM. The theme therefore came from these two codes: new skill set and learning to utilize it. Four interviewees mentioned something about the requirement of new skill sets and three mentioned that it requires time to learn how to use the technologies.

The next main theme that was identified through the analysis of the interviews was *AI used today*. The first theme *Development* was gathered through eleven interviewees saying that they already use AI tools to improve the quality of code, write code, write tests on code, and documentation of code, among other things. This is why the following codes were created: programming, documentation, and testing. The next sub-theme *Generative AI* was identified by the codes AI chat tool and AI code tool, in which ten interviewees mentioned that they use some form of AI tool or large language model in their daily work. AI tools like ChatGPT and GitHub Co-pilot were mentioned the most. The next sub-theme is more of a sub-sub-theme to generative AI which is companies that have their own *Corporate AI tool* which came from the code their own AI tool, which was mentioned by five out of the eleven interviewees in the generative AI sub-theme. The last sub-theme *Administrative tasks* was identified through the following codes: text generation, image creation, and creation of presentations. Seven interviewees mentioned that they use AI to write texts, improve existing texts, summarize meetings, create images for certain occasions, and/or use it to create presentations.

Potential of AI is another main theme with five identified sub-themes. *Product value* is the first sub-theme that was given through codes like improving products, removing features, and creating new products. Each of these codes improves the product's value and three of the interviewees mentioned one or more of the codes. The next sub-theme is *Aid in decision-making* and was mentioned by five of the interviewees who said that they use or see the potential usage of AI in predictability to make decisions and to use AI as a tool to make decisions on existing products. This is how the codes' predictability and aid came to light. *Tool/assistance* is the next sub-theme which was identified through the codes assistance and tool, which four interviewees mentioned. They see great potential in using AI as a tool or assistance in their daily work to improve efficiency within SPM. Another sub-theme is *Effectiveness within development*, which came from the codes programming, testing, and decision making which four interviewees discussed and said that they see a high potential with AI in the development phase of a product. The last sub-theme is *Productivity* which is for the efficiency and productivity that come with AI in SPM. The codes identified were time-saving, aid, and efficiency with AI tools. Two mentioned that AI and ML can save time, five mentioned that it is a great tool/aid,

and seven interviewees mentioned something about improved efficiency with AI and ML tools.

The last main theme with sub-themes is *Automation and Feedback-loops*. It is regarding other tools than AI that can aid SPM with digitalization. The first sub-theme identified was *Continuous integration/delivery/deployment*. The theme was gathered through the codes continuous integration, continuous delivery, and continuous input, among others. Seven interviewees mentioned that they use one or more of these codes in some form to further help their development process. The next sub-theme is *Customer centric focus* which is to always have the customer's interests and wants in the back of the mind when making decisions regarding a product. Ten interviewees have in some form a strong focus on the customer when developing or upgrading a product. The following codes are a result of that; customer data, demos, and interactions. Customer data is the gathering of all sorts of data regarding customer needs, behavior, and who they are. Demos are about including customers in decision-making to meet their needs. Interactions refers to interacting and communicating with the customers regularly. Then there is the sub-theme *Product feedback* which refers to how the product performs in terms of the amount of errors and faults it has. The codes internal faults and predictions were the main ones that led to the theme. Three discussed how an AI can potentially detect faults before they happen and alarm when an error has happened. The next sub-theme is *Customer feedback* which was made through the codes frequent feedback, and feedback. Every interviewee received feedback from customers. The discussion point lay in how often. Eight interviewees received somewhat frequent feedback from their customers in the form of complaints, demos, retrospectives, discussions, etc. The others received feedback less frequently. The last sub-theme is *Automation* which is regarding the automated process during the development of a product. The codes here are automated tests and automated deployment. Four interviewees mentioned that they have some form of automation process. Most of the processes mentioned were in testing.

The last three themes have no sub-themes and are by themselves as shown in Figure 4.1 in the bottom right corner. The first theme is *Training and information available* which refers to what kind of training employees in the organizations have had, if any. It also refers to what information or policy has been issued on how to use and handle AI and ML tools within SPM an the company. The codes that led to the theme were courses, policies, guidelines, and training. Eleven interviewees said that they have some form of training available for their employees. Some were mandatory and some were not. Nine said that they have guidelines or policies for how to use AI in a good and effective way. The next theme is *Lack of discussions on AI ethics* which was gathered by the codes: security, no discussion, and general discussion. Security was an ethical aspect that was discovered by the analysis. Six interviewees mentioned some concerns regarding ensuring that company secrets do not get exposed and ensuring confidentiality. Eight of them had not discussed nor thought about the ethical aspects when it comes to AI and ML within SPM. Two had discussed in general some ethical aspects but not exclusively AI and ML. The

last theme *Agile Frameworks* developed through seeing that all of the interviewees use agile but in different shapes and flavors. Some use techniques like SAFe, Scrum, and Kanban, and others use combinations of them but almost all of them have adjusted the techniques according to the company's needs. The codes here were Scrum, SAFe, Kanban, and combination.

4.3 Presentation of overall findings from the SLR and interviews

This section aims to answer and discuss the results and findings regarding the research questions, which were presented in section 1.2. The answers to the research questions are based on the findings from the SLR and interviews.

4.3.1 RQ1: What challenges does software product management face when using AI and ML?

This section explores the key challenges identified in SPM as a result of integrating AI and ML technologies.

Integration Challenges. The SLR highlights that one of the main challenges is the integration of AI and ML into existing techniques and processes. AI and ML techniques require significant alterations in workflow and process management, which many current SPM frameworks are not equipped to handle. This can become a problem for SPM when introducing AI and ML as a new technology. For instance, the integration often demands enhanced data infrastructure and new skill sets among SPM roles, which can be resource-intensive and require substantial training.

From the interviews, several expressed concerns over both the adaptability of the techniques to existing systems and the team's adaptability to these techniques. There is a noted need for ongoing education and training in SPM for AI and ML techniques to ensure that the teams within SPM can leverage and use AI and ML effectively since they are very complex.

Trust and Understanding. In the interviews, it was evident that one of the core challenges with the complex technologies, AI and ML, is that teams and individuals do not trust them because they do not understand them. This can become a problem for SPM when introducing new technologies in the company. To be able to trust them, they need to get a clear understanding of how they operate and this can be done through training and courses. There is also a need for critical thinking that goes with trusting the technologies. The user of the techniques needs to be critical of what AI and ML tools produce. This is easier done when they understand how they operate.

Ethical, Privacy, and Security Concerns. Ethical considerations, particularly related to data privacy and the potential biases inherent in that data within AI and ML algorithms, are prominently discussed in the literature. The need for transparent, accountable AI and ML systems that ensure fairness and privacy protection and adhere to the company's policies and code of conduct is seen in both the interviews and the literature. The literature discusses the challenges that can arise in SPM with AI and ML regarding the privacy of customer data. It is important to consider these aspects in SPM when incorporating tools like AI and ML.

The interviews pressed a lot on security concerns with the risk of exposing company secrets with people using external AI and ML sources within SPM. There is a need for training in how to use external sources and information about what employees are allowed to use. This can also be solved by companies developing their own AI and ML tools but that takes a lot of resources. There needs to be updated policies on how customer data is used concerning AI and ML in SPM.

Cost Implications. The cost of implementing AI and ML within SPM is another important discussion. Both the literature and the interviews underscore the investment required not only money but new skill sets as well. In the interview, many stated that they see the benefit of increased efficiency and enhanced decision-making capabilities in SPM but beyond that, they do not yet know the use case for these technologies. This becomes a challenge in justifying the return on investment to both stakeholders and higher-ups in the company.

The integration of AI and ML into SPM introduces several multifaceted challenges including technical, ethical, and managerial dimensions. Addressing these challenges through a robust framework and ongoing professional development is essential for leveraging AI and ML effectively within the domain of SPM.

4.3.2 RQ2: How is software product management taking advantage of AI and ML within the products which they are responsible for?

What was mainly seen in the interviews is that there are no indications of effective usage of AI and ML in SPM today. AI and ML come with great benefits such as being able to go through a large amount of data in a short period of time and they can work 24 hours a day all days a week. This does not seem to be taken advantage of at the moment. Both the SLR and the interviews saw great potential with AI and ML within products but there was no indication that AI and ML are being used to their full potential in products. Many interviewees saw it as a challenge to find the right use case for AI and ML. This is what the produced framework is intended to answer.

Several interviewees mentioned that they could see potential use cases for AI and ML within the products in the future. Activities such as utilizing the data that

the components can gather in decision-making, working more proactively by finding trends, and utilizing tools for quality assurance were recognized to be possible usage scenarios. AI and ML models in components within products can also be used to predict system failures or identify potential issues before they affect the user experience. This not only improves the reliability of the software products but also enhances user's trust and satisfaction regarding the products.

4.3.3 RQ3: How is software product management leveraging AI and ML tools today, and what are the use cases for the tools in the future?

This section delves into how AI and ML are currently being utilized in SPM and the potential future applications of the technologies.

Data-Driven Product Development. One of the predominant themes from both the SLR and the interviews is the use or the potential usage of data-driven decision-making in SPM. AI is currently being employed to analyze user data because of its ability to analyze a vast amount of data rapidly, which helps SPM make more informed decisions about product development. The SLR and the interviewees see a huge potential in the future, together with AI and ML, to analyze market trends and competitive dynamics to inform product strategy for SPM.

Automating. Another significant advantage discussed in the literature and echoed by interviewees is the automation of routine and repetitive tasks. The traditional processes that required manual input, such as testing, certain aspects of code generation, and administrative tasks can now be improved with AI and ML. These tools significantly reduce the time to market and increase the productivity within SPM which gives time to spend on other, more creative activities.

Predictive analytics for market trends. Looking ahead, AI and ML can be used in predictive analytics to forecast customer behaviors and product performance on the market, facilitating proactive adjustments rather than reactive responses. By analyzing user behaviors more thoroughly than before and identifying features that will enhance the experience for the user, the products will become more personalized for them.

AI and ML are not only enhancing current practices in SPM but are also ready to transform the field in new profound ways. By leveraging these technologies, companies in SPM can anticipate market trends, enhance user experience, and improve operational efficiencies to increase product value. However, as these tools evolve, so too must the strategies for managing them, underscoring the need for a dynamic, adaptable SPM framework as developed in this thesis.

5

Software Product Management Framework

One of the goals of this research was to create an SPM framework that can help people within the industry navigate the challenges that AI and ML bring and understand how the new technologies can be utilized to maximize their advantages. The final framework presented in this section builds on the empirical findings from the SLR and the interviews and is validated by people who work within the field of SPM.

5.1 Outcome of the validation of the framework

The workshop and the interview were done to validate the first created SPM framework and its complementary perspectives. The first framework which is the framework that was presented to the participants of the validation activities is shown in Figure 5.1 and the perspectives are shown in Figure 5.2.

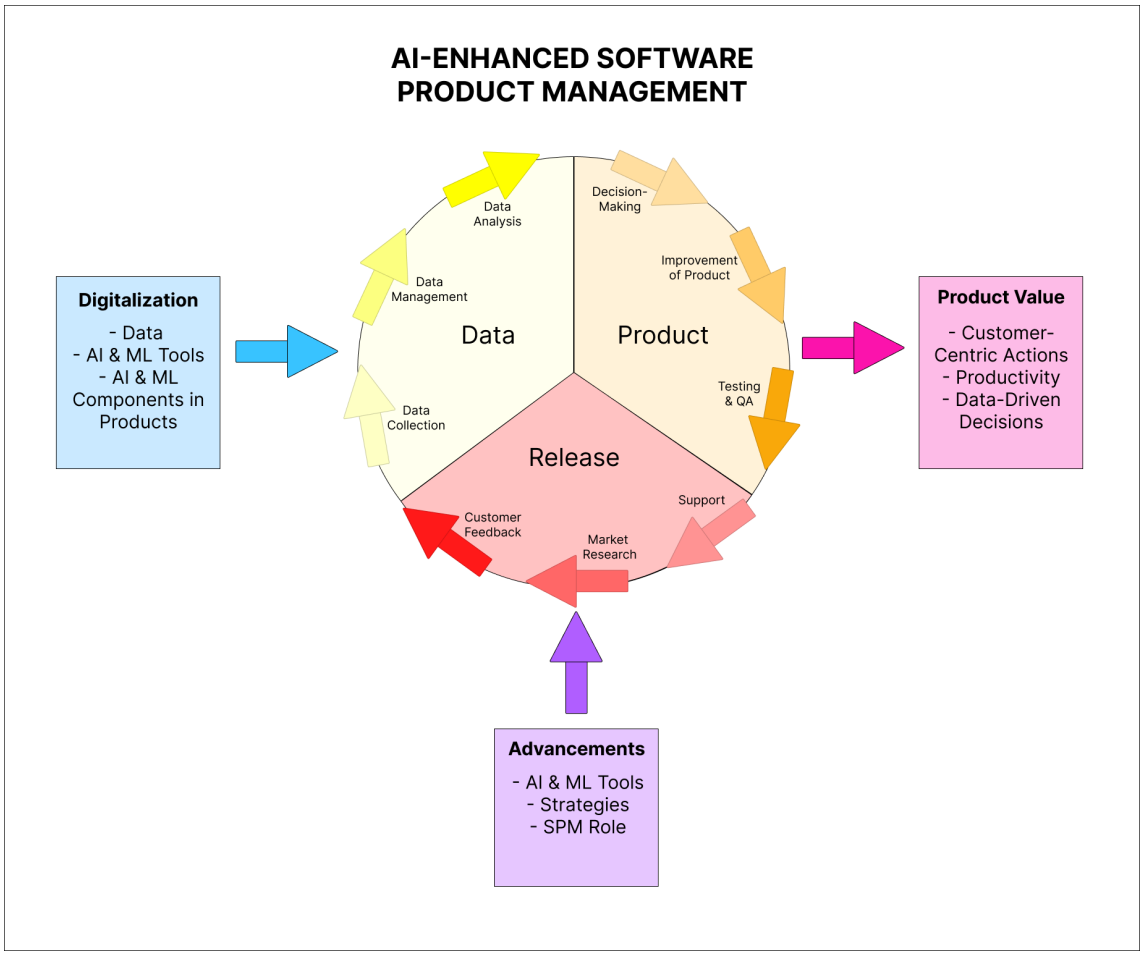

Figure 5.1: The first created AI-Enhanced Software Product Management Framework

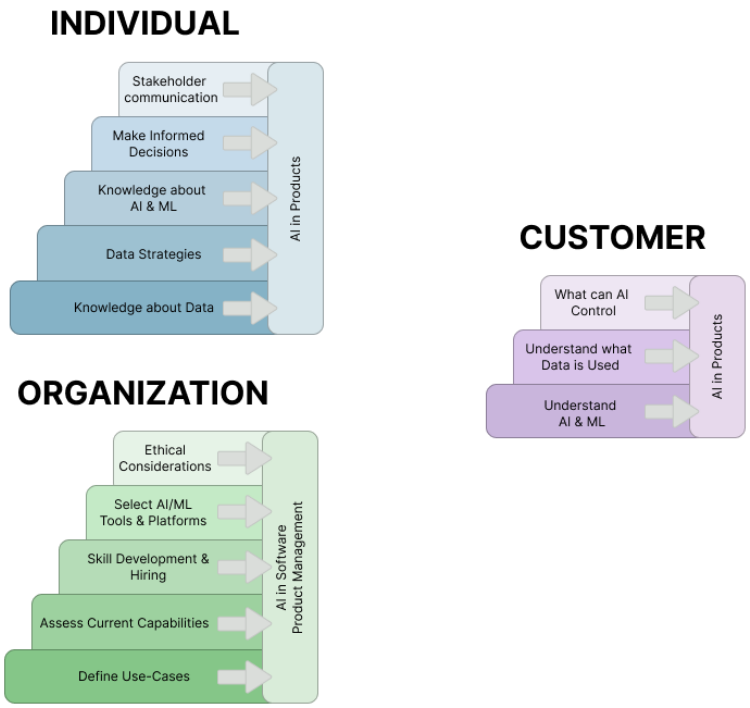

Figure 5.2: The first created perspectives

The created framework and perspectives led to a lot of discussions and feedback that contributed to an updated framework. See Table 5.1 for the discussion questions that took place during the workshop.

Table 5.1: Outcome of the validation workshop

Discussion questions	*Discussion outcome*
What is your first impression of the framework?	They like the overall structure, would like some examples of usage.
Is it clear and understandable?	Yes, they think it is clear and understandable.
Exploring ideas	
What advantages do you see?	That you get a high-level understanding of how AI and ML affect SPM and is easy to understand. They also thought that the different perspectives were a nice contribution to the framework and that they further explained the three main actors of SPM.
What disadvantages do you see?	They thought that it was high-level, which made it hard to see how to make use of the framework. Where do you begin and what are the entry points to the framework?
Constructing solutions	
Are there aspects that we should add to the framework or need further explanation?	They thought that the complexity of data (storage costs, legislation, and availability) needed to be added. They also thought that a section on what the risks are with using AI and ML as well as making it more clear how AI and ML affect the middle part of the framework (SPM). Lastly, they thought that the customer perspective should reflect all of the different types of customers that exist.
Are there aspects that we should remove from the framework?	They said that AI and ML tools exist in two different places, and wanted to remove one. They also said that in Product, Testing and QA can be removed since it is not a core SPM task. They mentioned that decision-making in Product can also be removed since SPM makes decisions on every aspect. Lastly, they mentioned that the framework is working sequentially which does not reflect how SPM works in practice. Data is part of everything.
Final reflections	
Takeaways from the workshop	They thought that there are still a lot of uncertainties in terms of AI and its practices and right now AI is viewed as a tool and for it to be successful it needs to be human-friendly. They said it is good that the framework is high-level since AI is changing rapidly and a more detailed framework would need to be updated more frequently. They could also see themselves using/taking inspiration from the framework in their work.

The interview brought up several points that had been discussed in the workshop. The interviewee mentioned that the struggle is often not the technology itself but rather the people surrounding it such as stakeholders and customers. The interviewee also stated that they liked the structure of a framework, but would like some examples of how to use it.

5.1.1 Changes made after the validation

After the validation activities modification and development of the framework were done. The changes that were made are explained in this section and the new framework is shown and presented further in section 5.2 and Figure 5.3.

The first framework presented in Figure 5.1 was changed with the assistance of feedback from the validation activities. The center of the framework was changed the most. The main changes are that an *AI and ML* aspect was added to the mix and that the relations between the different parts have changed. The participants thought that there was a need to illustrate further how SPM has changed with AI and ML and one of the solutions that they came up with during the workshop was to add an *AI and ML* aspect to the center of the framework. The two elements Tools and Components were added into *AI and ML* to explain the two main categories of AI and ML. AI and ML tools that can help with data, product development, and released products. AI and ML components in the product can help with data collection, management, and analysis, as well as creating a new revenue stream for SPM.

The *Data* aspect in the framework remains unchanged but in the description, the participants thought that the complexity of it was missed. The complexity that was discussed was the data's availability and all legislation surrounding data. In *Release*, market research was replaced by product positioning to make it clearer what it entails. Product positioning is regarding how the product performs on the market and what is missing in the product to meet the customers' needs. Customer feedback was changed to customer relations to not minimize the importance in SPM of building customer relations and also getting their feedback. In *Product Development*, testing and QA were erased because, during the workshop, the participants mentioned that it is not a part of the core activities within SPM. Decision-making was removed as well since in SPM, decisions are made throughout the entire lifecycle of a product, not exclusively within the development of a product. Decision-making was therefore replaced by Feature Engineering to highlight the decisions that are made during the development process and also further demonstrate the usability and effectiveness that AI and ML can bring.

The second and last main change that was made to the framework was the relationship between the different parts of the SPM section of the framework. This is because of a discussion that arose during the workshop about SPM not being as sequential as the previous framework suggested, see Figure 5.1. The sequential relationship was therefore removed and replaced by multiple relations to signify all

of the continuous relations between every part of the center of the framework.

When comparing the finalized perspectives, which represent the new and improved ones to the first created ones shown in Figure 5.2, the only perspective that visually changed was *Organization*. However, some explanations and motivations changed within the other perspectives based on the validation activities although the aspects and their names remain the same.

Within the *Invdiviual* perspective, which focuses on the individual within SPM, nothing changed visually, however, the feedback received during the workshop led to additional information within different aspects. Within the aspect that focuses on knowledge about AI and ML, a need arose to add a section on more critical aspects such as trusting the AI and determining the validity of the results of the AI. An additional thing that was brought up during the workshop was that the person within SPM is also responsible for the data that is proposed to the AI and therefore needs to have an understanding of how this influences it. Also, a conversation about the importance of addressing that all stakeholders might not have the expertise to grasp all technical details regarding AI and ML was highlighted. This point was therefore added within Stakeholder communication.

The *Organization* perspective is the perspective that has been changed visually by adding another aspect called Risk Assessment. During the workshop, a discussion regarding the risks that AI and ML bring was brought up, and the lack of portrayal of these within the presented framework and perspectives. One further change that was made to the perspective based on the validation activities, but is not seen visually, is the aspect of how complex and resource-demanding data is. Therefore, within the aspect Assess Current Capabilities, an additional explanation of this was added.

The last perspective, the *Customer*, was also not changed visually, but some supplementary explanations were added based on the discussions from the workshop. The first change made was that there now is a larger focus on the non-technical knowledge of customers and that you cannot expect them to grasp all technical details about AI and ML. The second aspect that was brought up during the workshop was that there are several types of customers which is not represented in the *Customer* perspective. Therefore, an explanation of this was added at the end of the description about the customers' role within the framework.

5.2 AI-Enhanced Software Product Management Framework

In Figure 5.1 the first framework created is shown. This framework was derived from the findings in the SLR and the interviews conducted with people working within SPM. Several different ideas of frameworks were explored to find the optimal one for representing the findings and to ensure that the framework would aid industrial

SPM in their journey towards utilizing the power of AI and ML.

The original thought was that the framework would be constructed to go hand in hand with agile frameworks and methodologies that appeared most in the interviews. However, what was discovered during this interview process was that many use the same agile frameworks and methodologies such as Scrum, Kanban, and SAFe, but in various ways. It seemed that the frameworks and methods were adapted to the individual companies. This made it hard to utilize a specific framework or method without leaving some companies behind. The framework is being made to be adaptable to the different agile frameworks and methodologies by involving the core principles of agile development such as continuous improvement and fast feedback loops.

The new framework, see Figure 5.3, displays how different aspects of digitalization and other advancements affect SPM and how these can be used to create more product value. The different aspects that come into the field are shown in boxes with arrows toward the continuous process of developing and managing a product. The arrow that comes out of the process presents the actions that the aspects that are brought into the process generate which leads to increased product value. Figure 5.3 presents the framework that has been validated and iterated according to the feedback received during the workshop.

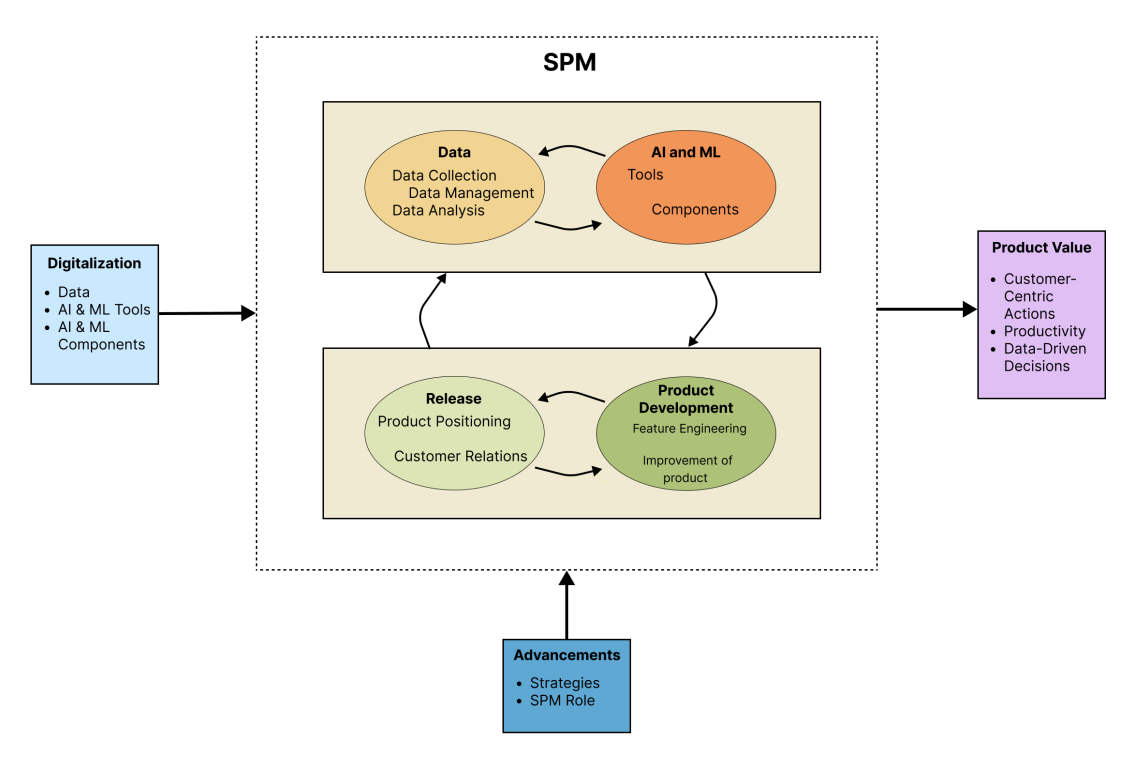

Figure 5.3: AI-Enhanced Software Product Management Framework

The first part *Digitalization* is a key component of the framework, representing the transformative effects of digital technology on the landscape of SPM. The focus

on digitalization underscores how advancements in AI and ML are reshaping SPM practices by introducing new tools and capabilities to add product value. These technologies facilitate the handling of large volumes of data, which is pivotal for both the development of AI and ML applications and for enhancing decision-making within SPM. By adding data to the framework it signifies the importance of data within SPM and will help the companies who are struggling when it comes to data. Data is also the foundation for successfully developing and the continuous usage of AI and ML.

Data. Data has been around for some time now and has so far mainly been collected and analyzed by people. With the new technologies that come with digitalization, data can be collected and managed at a larger volume than ever before. This allows for deeper analysis and smarter programs that can be used in a variety of fields. This was mentioned mostly by the SLR, but also by the interviewees. In SPM this means gathering more insights into customers' behavior and finding out their wants and needs for a product to increase the product's value. Data can also provide factual insights which are critical for making well and informed decisions and it also acts as a base for the development of other technologies.

AI & ML Tools. AI and ML tools are becoming popular to use throughout various domains and they can increase the productivity and effectiveness of SPM and help with improving the products. Generative AI has become popular as of late with tools like ChatGPT that can help with administrative tasks. GitHub Co-pilot or Microsoft Co-pilot are other AI and ML tools that can help the development of a product. The possibility of utilizing generative AI in development was mainly brought up during the interviews. However, these tools also introduce challenges that need to be accounted for such as how to understand and trust the results of the tools, learning how to use them in a correct way to produce the best results, and finding the optimal use cases for them. This was mentioned in both the SLR and during the interviews

AI & ML Components in Products. AI and ML components within the products themselves change the way that SPM is done because these modules introduce new possibilities and challenges. Opportunities for new products incorporating AI and ML components benefit both the end-user and the product creator and will create a new revenue stream. This was supported by the SLR. For example, the user can use an AI note taker while in a meeting or the maker can use a built-in AI or ML component to analyze data quickly. A challenge with this is integrating AI and ML into already existing products.

This next part focuses on the *Advancements* within the industry and how these different aspects affect SPM. These are aspects that are not directly related to digitalization but more regarding perspectives and actions that are done to enhance the effects of the digitalization aspects. *Advancements* represent the technologies, strategies, and changes made in the role of SPM as a further aid in this journey.

Strategies. Different strategies should be used to maximize the advantages of digitalization and to have the base to handle the data and the technologies. DevOps and fast feedback loops are techniques that should be applied because they ensure that enough data is coming back to SPM to make informed decisions. They increase automation to streamline processes and accelerate delivery, which was supported by both the SLR and the interviews. By utilizing techniques such as continuous integration, delivery, and deployment it is possible to continuously provide the customer with new versions of the software quickly to respond to the ever-changing environment. A/B-testing is another method that allows the company and SPM to gather more data about the product's performance and placement by releasing different versions of the product and tracking their usage to understand which version works best.

SPM Role. How the role within SPM needs to be changed is another element that is considered. First of all, it affects the decision-making process since there is a lot more data that can be analyzed and taken into consideration, making the process more data-driven. This was taken mostly from the SLR. Secondly, with the introduction of AI and ML within different parts of the role, there is, as presented before, a need for a new skill set to be able to handle these powerful components. With new skill sets comes the need to have knowledge about the techniques to be able to maximize their utilization. This was mentioned in both the SLR and the interviews.

Knowledge. The person responsible for the product and utilizing AI and ML tools must have a basic understanding of these technologies, as it is essential for presenting and defending the product to stakeholders and comprehending the associated challenges. Knowledge about data is equally important, as data from feedback loops on customer and product behavior must be strategically collected, managed, and analyzed to be useful, which is supported by both the SLR and the interviews. Data is also the foundation which AI and ML tools are built upon, which makes data knowledge an important factor of SPM.

Critical thinking is another skill that is required in the future of SPM. It has always been important but it becomes even more so with the introduction of these technologies. To be able to let AI, ML, and the data it is based on help in various activities such as decision-making, the role needs to critically analyze the results that the AI and ML produce, which was mentioned during the interviews. They need to understand how the AI has made the decision and why because the role will be held accountable for the decisions that they make. If SPM does not understand the insights that AI and ML are basing their decisions on, it could turn out bad for the company and the product.

Activities. Digitalization will fundamentally change the way that SPM is done. Activities that SPM will be able to utilize with the technologies are requirements prioritization since the data will help to bring insights into what

features and demands should be moved higher or lower in the backlog. Market and product analysis, performance, and risk management are other activities that will be affected by the transformation since they can be effectivized with the help of data and AI components. This was mentioned in the SLR. Analyzing customer data can be done by AI and ML to gather understanding about the customers and analyzing product data can help to understand how the product is performing on the market, which was supported by both the SLR and the interviews.

By utilizing the possibilities to increase the effectiveness of the presented activities above, more time can be spent on higher-value tasks such as stakeholder communication and getting to know the customer and its users. This was mentioned in both the SLR and the interviews. More time could be spent on innovation to increase product value and ensure competitiveness. However, extra time could be needed to be spent on legal and IPR management due to the new technologies that bring, among other things, ethical challenges.

There are other important activities within the core of SPM that AI and ML could assist with. A lot of these activities are planning activities and activities that focus on long-term vision and goals for the product such as roadmapping and financial management. These are activities that could be assisted by AI and ML tools but still need to be done by the person responsible for them. This was mentioned in the SLR and in the interviews.

At the center of the framework, the overview of SPM illustrates how the integration of AI and ML represents a new and improved approach to SPM, highlighting the impact of these technologies on data, product development, and release.

The relationship between *Data* and *AI and ML* is symbiotic, see Figure 5.3. Data is essential for building, training, and improving AI and ML technologies, while these technologies, in turn, enhance data gathering and analysis, making the process more efficient and productive. AI and ML components also generate additional data. Both *Data* and *AI and ML* are considered the "upper box". The "lower box", which represents *Product Development* and *Release*, is focused on the SPM process, see Figure 5.3. This relationship is represented as a continuous loop, where products are developed, released, and continuously improved, indicating a back-and-forth flow. The connection from the upper box to the lower box demonstrates that data and AI and ML continuously influence product development and release process. Conversely, the lower box feeds data back to the upper box for AI and ML to process and manage.

The center of the framework presents an overview of how SPM has changed and represents the new and improved way of conducting SPM with the added technologies, AI and ML. It intends to show how data, AI, and ML affect the SPM process when it comes to the product itself.

Data. One vital aspect that was mentioned throughout the interviews, workshop, and SLR was the importance of data. Data is an important part of SPM and with the introduction of AI and ML within products as well as the potential to use AI and ML tools for increased efficiency the aspect becomes even more vital. Data is the base for AI and ML and without an adequate amount of good-quality data, the powerful technologies become ineffective. Data also has an added complexity such as storage and availability.

Data Collection. Data is collected from the product and the customer's usage of the product. Product data could for example be, as stated before, information about failures or errors and customer data could be regarding which features are used and which are not. Data comes in all forms and sizes and it can be difficult to understand what different types mean and what insights they have. With the help of AI and ML components, data collection is easier and there is a large amount of data that can be utilized in upcoming steps, which was supported by the SLR and the interviews. However, not all products can always stay connected to collect data and not all data is accessible such as some personal data about the customer. This was mentioned during the workshop.

Data Management. The importance of data management was brought up by both the SLR and the interviews. The collected data then has to be managed by preparing and organizing it to be able to perform data analysis on it. AI and ML components, DevOps, and fast feedback loops allow for more data to come back into SPM. Storing data is costly and by increasing the amount of data, the need for more storage arises which increases the cost. However, large amounts of unsorted data can be tough to analyze as was mentioned during the workshop. The data needs to be sorted to easily visualize it and in this part, AI and ML tools can help to obtain more knowledge about the storytelling of the data, which was taken from the SLR.

Data Analysis. Data analysis is trying to visualize and interpret data to be able to find new insights that can be used for additional development of the product. AI and ML tools can help in finding understandings and patterns that a person would have trouble discovering, which was mentioned in both the SLR and the interviews. These tools can also help to effectivize the analysis process since they can go through these large amounts faster than a human. This was taken mostly from the SLR and the interviews.

Data is crucial for SPM and becomes even more vital with AI and ML integration for enhanced efficiency. AI and ML facilitate easier data collection, though continuous connectivity and access to personal data can be issues. AI and ML tools help sort, visualize, and analyze data, uncovering patterns and insights for product development more efficiently than humans.

AI & ML. AI and ML represent the new technologies that have affected the way

SPM is done. AI and ML are technologies that can help in almost all aspects of SPM. It can help with the efficiency and productivity of product development and help analyze customer behavior to make more informed decisions which increases the product's value. This was mentioned in the SLR, interviews, and the workshop.

Tools. AI and ML tools are meant for internal usage in the company to improve SPM, from product development to product release. Improvements for SPM are less administrative work since an AI or ML tool can make presentations, write texts, summarize meetings, etc. Decisions made in SPM can be made based on data that an AI has collected and analyzed, which leads to well-informed decision-making that can further improve a product. This was mostly mentioned during the interviews and SLR but also during the workshop. By having tools like a corporate AI tool that has access to the internal web of an organization, people within that organization can get relevant information faster.

Components. AI and ML in components was a topic that was brought up in the SLR, which aims to cover the usage of the technologies in a product. It can create a new revenue stream by adding it as a feature for the customer to use within a product. The components can also be added to a product to gather and analyze the usages of that product to easier get information about the possible improvements before the customer has to ask for it, which is supported by the SLR. This helps SPM work proactively rather than reactively. All of this leads to the automation of processes such as data gathering, data analyzing, and self-improvement of the technologies.

Product Development. As customer requirements change frequently, ongoing product enhancement is essential in SPM. By leveraging strategies that facilitate continuous data gathering, the power of AI and ML can be used to optimize features to improve the product and add product value, which leads to increased customer satisfaction.

Fetaure Engineering. Feature engineering in SPM is an important activity that involves different aspects such as defining, removing, adjusting, prioritizing, and effectively communicating the features of a product. This can be aided by the use of AI and ML. These technologies can analyze the existing product to identify improvement opportunities, which involves defining new features. This requires a deep understanding of market trends and technical possibilities, which AI and ML can help with. Defining features includes understanding what is not used and can be removed, needs adjusting, and defining completely new features. Requirement prioritization can be done by an AI and ML tool which will aid in the development of the product. This was mentioned during the workshop and supported by the SLR. This was It involves regularly updating and consulting with all stakeholders, including developers, executives, and customers about the feature decisions and their

importance.

Improvement of Product. Decisions made from data analysis contribute to product improvement and, consequently, increase product value. The goal is to continuously deliver a product that meets evolving customer needs. The product needs to be further developed and tested before it gets released to its customers, wherever it is internally or externally. This process can be helped by AI and ML tools and other strategies like DevOps, which was mentioned during both the SLR and the interviews. AI and ML can help develop, test, and quality-check the new and improved product before it gets released while DevOps helps streamline and automate the process. It is an important part of SPM to continuously create new value for the customer by improvements of products.

Release. After the product is tested and quality checked it is released to the market. When the product is released, it can be monitored in different ways to see how it performs and understand how it works on the current market.

Product Positiong. Something that was mentioned during the SLR was the importance of understanding the market and how the product is doing on the market. This is done to be able to be predictable for upcoming improvements of the product to ensure success. Understanding the market is an important part of SPM because you want to understand the market's demand to be able to supply the appropriate products for it. Not understanding this can lead to unused products and economic losses.

Customer Relations. The importance of having robust customer relations is mentioned by both the SLR and during the interviews. Strong relationships help ensure customer satisfaction, encourage loyalty, provide valuable feedback, and foster continuous improvement of the product based on real user experience, which was supported by the SLR. AI and ML tools such as chatbots can provide instant support to customers, answering common questions and solving simple problems around the clock, which can aid customer relations.

Product Value presents how increased product value is achieved by implementing and focusing on the advantages that digitalization brings to SPM. With the help of AI and ML technologies, strategies, and data, SPM will become more customer-centric, more productive, and make more data-driven decisions.

Customer-Centric Actions. SPM becomes more focused on customers and can create products that revolve around their needs and preferences. By placing the customer at the center of SPM and leveraging advanced techniques such as AI and ML, SPM becomes more customer-centric. These technologies allow for the collection and analysis of vast amounts of data, providing insights that drive informed decision-making. By also collecting customer feedback and us-

ing AI chatbots for customer support, SPM can take targeted actions based on that data, ensuring that the products not only meet but exceed customer expectations, leading to increased satisfaction and loyalty.

Productivity. AI and ML tools can help in all the phases of the development of a product, the release of a product, and the data gathering from a product to improve productivity and efficiency. By using AI and ML to gather and analyze data, decisions will be made quicker and more in terms of what the customers need. AI and ML tools can aid in administrative tasks such as making presentations and writing text, which saves time. Improving productivity and efficiency within SPM increases product value by having shorter time to market and better quality products.

Data-Driven Decisions. Making decisions based on data collected from customers and products enhances product value, as these decisions are grounded in customer preferences and insights, ensuring they are aligned with customer needs. This approach allows companies to make informed decisions, reducing the risks of product failure and increasing customer satisfaction. By utilizing AI and ML tools, SPM can efficiently analyze vast amounts of data to uncover patterns and trends that may not be apparent to the human eye. These technologies can generate actionable insights, leading to decisions that not only improve existing products but also inspire the creation of entirely new product ideas. This proactive approach to SPM ensures that companies remain competitive, innovative, and responsive to market demands, ultimately driving growth and success.

Overall, the framework blends current practices and emerging technologies in SPM, shaped by extensive research and real-world industry insights. It aims to guide professionals to navigate the complexities of digitalization and leveraging AI and ML to drive product value and innovation.

To delve deeper into different aspects that are affected and to show how various viewpoints are influenced by AI and ML as well as how they should adjust to utilize the advantages properly, different perspectives were created. The perspectives were derived from the need to complement the framework in Figure 5.3. The creation of the diverse dimensions came from the different actors that presented themselves in the SLR, the interviews, and during the workshop.

In Figure 5.4 the derived perspectives are presented, which are *Individual*, *Organization*, and *Customer*. The *Individual* perspective focuses on the role within SPM and how the role needs to adapt to work with AI and ML components in products and AI and ML tools. The *Organization* perspective centers on the different focus for the organization to consider if they want to assess their work towards implementing AI within the field of SPM. From an SPM perspective, the *Customer* perspective is about what the customer needs to implement AI within the products and processes.

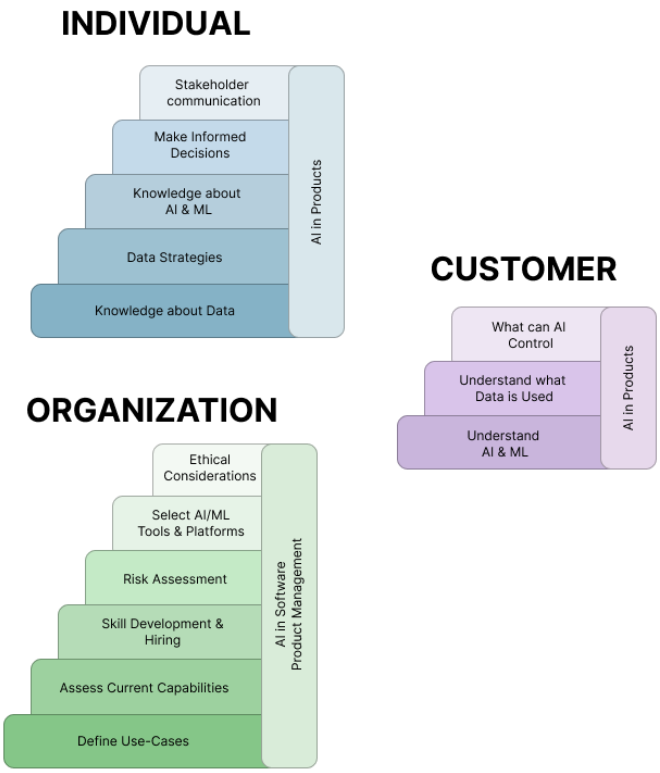

Figure 5.4: Perspectives

This thesis focuses on the people within the field of SPM and therefore the *Individual* perspective was created. The focus of this perspective is to help the individual understand what actions need to be taken to confidently apply AI and ML components in products as well as apply AI and ML tools within the role effectively.

Knowledge about Data. Data knowledge is vital in the role within SPM as supported by both the SLR and the interviews. The concept of data is complex and it becomes even more important due to the large amounts that can be gathered. If data is used correctly, it can create more product value by taking more customer-centric actions. The person within SPM is liable for the data input for the AI/ML model. With the aim to produce credible results, the individual needs to understand how the data input affects the model and its results to ensure comprehension of the output.

Data strategies. The importance of different data strategies is added because they are needed to be able to utilize the capabilities that AI and ML in the product provide. This aspect is vital and is backed by both the interviews and the SLR. Without having proper strategies that help to organize, sort, and analyze the

data, there is no point in gathering more data about usage and the product. Having data strategies in place will make the process of finding useful insights within the data more effective.

Knowledge about AI & ML. The individual within SPM needs to know about AI and ML which is mainly supported by the SLR. AI and ML are relatively new technologies and since they are revolutionary and have a large impact on products, it is important within SPM to know about them to understand their impact. The person responsible must understand what the AI produces and how it came to that specific result. The person needs to be careful in regards to completely trusting the results and be able to comprehend how valid and correct the results are. It is also vital to understand how it could affect the products and its stakeholders.

Make informed Decisions. With the advantages of introducing AI and ML technologies to products and processes, the possibility of making more informed decisions arises. Several interviewees mentioned that utilizing AI and ML tools can aid in decision-making which is also supported in the SLR. By taking advantage of the power of the technologies by introducing them into products and into the role, more data can be gathered and analyzed which allows the field to make decisions that are based on actual usage that will help it to understand the product and its user better.

Stakeholder communication. The person that works within SPM is responsible for communication between internal and external stakeholders and all of these parts must be aware of the new technologies that are brought into the development and into the product itself. This is supported by the interviews. This is necessary because of the impact that the technologies can have. However, as discussed in the workshop, it is important to acknowledge that not all stakeholders have the technical knowledge to comprehend all the details of AI and ML. This is both in regards to the AI and ML components within products and the explanation of how AI and ML tools are utilized within the development of the product. Therefore, it is important to make sure that the explanations and justifications for those topics are customized to a level that suits the specific stakeholder but still explains the depth and width of the effects that the implementation of the technologies can introduce.

The second perspective, the *Organization*, focuses on what the organization needs to do to ensure that there is a basis for utilizing AI and ML tools and components within products. Based on the SLR and the interviews conducted, several aspects centered on the organization's role in the journey towards applying AI and ML within SPM.

Define Use-Cases. AI and ML components and tools are new technologies that need to be learned how to handle correctly. It can be hard to understand where these techniques can be applied and their optimal use cases for the

products. This aspect was something that was brought up as a challenge in several interviews. Because most products and organizations work differently there is a need for the organization to assess and define what the optimal use cases are in their different environments. They need to determine where they can utilize these technologies to make the most out of them as well as where they are able to implement them in products.

Assess Current Capabilities. The next aspect for the organization to take to contribute to the success of implementing AI and ML within SPM is to assess their current capabilities. This was brought up in the SLR and is a necessity because different organizations have different capabilities and can therefore accomplish various things with their resources. Companies with more resources can develop their own tools that are trained on their company data, however, this is not the case for all organizations. The resources include funding, knowledge, and technical skills within the company.

To gather, manage, and contain a lot of data is costly for the company, which is why it is important to acknowledge this when assessing the resources. It is beneficial to gather larger amounts of data because it provides additional insights and more fuel to AI and ML tools but as stated, a larger amount is costly to store and manage. There is a trade-off that requires investigation and discussion.

Skill Development & Hiring. Since the introduction of AI and ML are a relatively new phenomenon within the field of SPM it is necessary to develop the skills within the organization that allows for a better handling of these technologies. This was mentioned in the SLR and also in the interviews. Overall, utilizing AI and ML tools within the role can be hard and the organization can facilitate this learning by providing information and training to their employees. Hiring new people who already possess the skills required is also a solution and they can help with training teams and individuals.

Risk Assessment. Challenges and risks have been brought up in both the SLR and the interviews and there could be other ones depending on the type of the company and what product the company provides. Assessing and defining what risks the company could be exposed to can enhance understanding and ensure that the company addresses risks to decrease the probability of them happening.

Select AI/ML Tools and Platforms. The organization needs to provide the tools and the platforms that they want their employees to use to make sure that there is a common ground. As mentioned previously, if the company has resources, there is a possibility to develop an intFiernal tool. In the interviews, the different companies used diverse tools and platforms, and to facilitate a shorter learning curve, it can be beneficial for the organization to provide a common tool or platform for the employees to use. Also mentioned in the

interviews were the security concerns regarding utilizing external tools and company data which could potentially lead to data leakage. Therefore the organization needs to prevent this from happening by choosing tools and platforms for their employees that the organization has approved for use.

Ethical considerations. An important aspect that was discussed in the interviews and mentioned in the SLR and needs to be considered is the ethical aspects of using AI and ML within products as well as utilizing tools to aid in various activities within SPM. Several perspectives need to be investigated to use the technologies. Privacy of the customer and their data as well as security of data in general to minimize data leakage. The intellectual property rights (IPR) aspect is large and regards how the data is handled and what data is taken. Another aspect is the bias that can easily arise when training AI and ML on data that has some sort of bias.

The third, and final, perspective that was created is *Customer*. This perspective focuses on what the customer needs to be aware of. During the interviews, there was a lot of focus on the challenge of understanding what AI produces and if it produces good-quality results and also on being more customer-centric. Because of this, a customer perspective was constructed.

The customers are stakeholders who generally do not know much about AI and ML. While they can have basic knowledge about what the technologies bring to their field, more technical details can be confusing. This conclusion affects all three aspects from the customer's perspective.

Understand AI & ML. AI and ML are technologies that have a large impact on the products and their usage. It is therefore important for the customer to be able to understand what AI and ML are and what differences the introduction of them into the product brings. The advantages of them are often highlighted but they must be aware of the challenges and risks. Another challenge is that customers often do not want to investigate and learn about new technologies, they prefer to stay out of the more technical parts. Therefore, it can be difficult to make them gather knowledge about AI and ML.

Understand what Data is Used. Data is the foundation for AI and ML and therefore the customer needs to understand what data is used. This is related to ethical aspects such as privacy and IPR because the data can be related to the customer's and the product's users' information. This was mentioned frequently in the interviews. There is a trade-off between gathering all data possible and by doing that, potentially violating ethical aspects, and making sure that the technologies have enough data to provide sufficient results.

What can AI control. The third aspect of the customer perspective is that they have to understand what AI currently controls and what it should be allowed to control. Providing AI components in products can help with adjusting

product settings based on data trends and this can be an efficient way to automate certain aspects. However, allowing the AI to control more things than simple tasks is a discussion that needs to be taken to ensure that all parties understand and agree on it.

There are different levels of customers that the companies provide products for. For example, the case could be that a company provides a product for a customer who utilizes the product as a component within their own product and has their own customers for this new product. This means that the company that provides the component product cannot ensure that the end customer knows about AI, understands what data is used, and knows what AI can control. Another example is when a team releases a product internally that another team utilizes for their product that is released to external customers. The same issue arises here as in the first example.

These perspectives, as mentioned before, are created to complement and support the framework's comprehensibility.

5.2.1 Framework use cases

Due to integrity issues with conducting a real-world case within a company, two novel use cases are presented to illustrate how the created SPM framework and its complementary perspectives can be utilized in actuality.

5.2.1.1 Use case 1 - AI-Driven Customer-Centric Transformation

This use case demonstrates how AI and ML can transform SPM by enabling smarter, more customer-focused decisions by gathering more customer data to support customer-centric actions that will drive product and business success forward. The use case demonstrates how the challenges of incorporating AI and ML into products affect the processes of working and communicating with various stakeholders, and also illustrates the struggle of adding AI and ML into an existing system.

Background. Alice has been at the company for over three years in her role as a software product manager and has great knowledge about the concepts of data as well as AI and ML. She also has a good overall understanding of the company's capabilities. With AI and ML entering the market, Alice and the company she works for want to incorporate the technologies to utilize their advantages. Alice's company aims to enhance its existing customer relationship management (CRM) software with AI and ML capabilities to improve customer interaction and predictive analytics, thereby building better customer relations and making better products.

Goal. Implementing AI features to the existing CRM software to automate data collection, enhance data analysis for making predictions, and improve market responsiveness. This leads to an increase in customer satisfaction and operational efficiency.

Organization. The company that Alice works for has wanted to utilize the advantages of AI and ML for a while and therefore they have investigated how they as a company can best use the technologies as well as selected the tools that they are planning to use. They also have examined their resources and have concluded that they have the skills necessary to drive this change forward. During the discussion, the company also acknowledged the ethical aspects of the utilization of AI and ML. Although the company is eager to start using the technologies in various ways, they have not conducted a proper risk assessment to understand how implementing AI and ML can affect them negatively.

Implementation

Risk Assessment. Evaluate the potential risks that come with implementing AI and ML into the product and investigate solutions and proactive actions for handling them.

Digitalization and AI Component Selection. Identify the necessary digital components and AI and ML tools that align with CRM software's needs that are within the company's capabilities.

Data. Implement automated systems for real-time data collection from multiple points including, social media and customer support calls and emails. Utilizing ML algorithms for efficient data management and to clean, sort, and prepare data for analysis.

AI and ML Integration. Develop and train AI and ML models to predict customer behavior and preferences based on historical data. Then integrate them into the CRM software.

Product and Market interaction. Launch the AI-enhanced features in a controlled market segment to monitor the initial response and gather user feedback. Use AI-driven insights to refine the product features and align them more closely with market needs. Analyze the performance of the AI enhancements in the CRM software, using advanced AI analytics to understand the product's positioning and customer satisfaction levels.

Predictions. By using the data that comes from the new and improved CRM software, making predictions about products and customers gets easier. The predictions will be based on data that provides more details about the market and the customer.

Product Value. Leveraging the AI-enhanced CRM software to execute customer-centric actions such as personalized customer interactions and proactive service adjustments increases product value. Enhances productivity by automating routine tasks and processes, allowing Alice to focus on higher-value activities such as stakeholder communication.

Challenges. A challenge for Alice could be that she needs to be able to communicate the value of adding AI and ML into the CRM software. This can be hard since these technologies have not been around in this context for very long. Stakeholders, especially the customers, often do not have the greatest understanding and knowledge about the technical aspects of products. They need to get an overall understanding of what AI and ML are and how they can help and create value in this case, which includes what data is being used about them to develop these tools and components. Alice needs to be able to accomplish this. Integrating the AI and ML models into the CRM software poses a great challenge since it is two different technologies that need to be combined. Alice needs to ensure that they are testing everything properly and integrating it in a way that does not harm the existing software.

Outcome. With the successful integration of AI, the CRM software becomes more adaptive and predictive, offering personalized experiences that significantly enhance customer satisfaction and engagement. Alice's company experiences an increase in customer retention rates and operational efficiencies, reinforcing the value of incorporating AI into SPM.

5.2.1.2 Use case - AI-Powered SPM for Novices

This use case illustrates how AI and ML can be integrated into SPM for a beginner with little experience in both SPM and AI and ML. The focus is on how to improve decision-making and feature engineering with AI and ML.

Background. Bob has recently transitioned into the field of SPM with minimal prior knowledge of AI and ML technologies. He has been at the company before in a different role but does not have any prior knowledge about how the company has introduced AI and ML into its products and processes. The company wants to utilize these new technologies to minimize the development of unsuccessful features and ensure that decisions are made more efficiently. Therefore, Bob is tasked with enhancing product features and improving decision-making processes within his organization using AI and ML.

Goal. Bob aims to utilize AI and ML to streamline product development cycles, enhance feature prioritization, and improve decision-making. This will lead to increased productivity, a shorter time market, and data-driven decision-making.

Organization. Since Bob is new to the field of SPM and the introduction of AI and ML he needs to investigate how the company has prepared for the implementation regarding different aspects. To ensure everything proceeds smoothly, the company needs to have thoroughly investigated potential use cases, their capabilities, competence, possible risks, and ethical aspects. Bob also needs to determine whether the company has decided on specific platforms to use.

Implementation

Education and Training. Because of Bob's lack of knowledge and skill with AI and ML, he needs to get a foundational understanding of AI and ML applications within SPM. Therefore, he will begin by attending workshops, completing online courses on AI and ML basics, and going to conferences within this field.

Automation with DevOps. To increase the speed of the development cycle, Bob can utilize strategies such as DevOps to enhance automation and enforce faster feedback loops that allow for continuous improvement of the product.

Data. After ensuring that faster feedback loops are implemented which gives Bob more data to utilize when doing feature prioritization, he needs to make sure that this data is managed and analyzed in a way that brings insights for him to make informed decisions.

AI and ML Implementation. Implement AI-driven analytics tools for user behavior analysis, and deploy ML models for feature testing and feedback analysis. The aim is to integrate AI tools to automate and optimize these processes.

Monitoring and Evaluation. There is a need to assess the effectiveness of AI and ML integration by regularly reviewing performance metrics, gathering stakeholder feedback, and adjusting strategies based on the outcomes.

Product Value. The product value comes from being able to streamline processes with DevOps, AI, and ML to get an improvement of a product out on the market faster. It also creates value for the product and the customers with predictive analysis which means a product can come with an update before the customer even has to request one.

Challenges. A challenge for Bob that occurs is that he will have to do a lot of preparation work before the actual implementation of AI and ML. He needs to have knowledge about data, AI, and ML and he needs to know the existing software systems work in order to know how to incorporate it. He also needs to assess the amount of preparation work the organization has done in regard to AI and ML. Another challenge for Bob will be to convince stakeholders of the benefits and potential return on investment (ROI) of investing in AI and ML technologies, even though he has no previous experience with it. He also needs to ensure that the data is of high-quality, to train AI and ML models effectively. Addressing potential biases in AI algorithms and maintaining transparency in AI-driven decisions may become another challenge for Bob.

Outcome. Bob's professional growth in AI and ML applications within SPM is hopefully an outcome for him. SPM will improve its alignment with user expectations by only developing essential features, leading to higher satisfaction and engagement as well as enhanced product development efficiency through informed

decision-making and automation, adding to the product value.

5.2.2 Framework summary

To recapitulate and sum up, the goal of the SPM framework presented in this chapter is to help and guide people within the field to utilize the advantages of AI and ML effectively. By addressing the challenges that the technologies bring, the people using the framework can create more product value by performing more customer-centric actions, becoming more data-driven, and increasing their productivity.

The framework displays how various parts of digitalization and different advancements within the industry will help to create more product value. The main part of the framework shows the relation between the core of SPM and how data and AI/ML are integrated into it as well as different activities and integrations that affect the digitalization of SPM.

To accompany the framework, three perspectives were created. The perspectives complement the framework by delving deeper into how different relevant actors have to adjust to increase success and minimize the risks of implementing AI and ML into the products and processes.

Finally, to demonstrate how the created SPM framework and the perspectives can be used in reality, two different use cases were presented. These use cases present diverse goals and challenges and show how the framework can be applied to help target the goals and solve the challenges.

6
Discussion

In this chapter, a discussion of the obtained results is conducted, aiming to interpret, contextualize, and evaluate the findings. The discussion delves into the significance and implications of the results especially the SPM framework, addressing both the theoretical and practical aspects of the study.

6.1 Framework discussion

Based on the findings from the SLR and the interviews, that helped answer the study's research questions, a new SPM framework was created to address the challenges as well as guide individuals and organizations through their journey to utilize the power of AI and ML to make the most of them. The created framework differs compared to the SPM frameworks presented in section 2.3.1 because it addresses the effects that AI and ML have on the field. The frameworks from section 2.3.1 have different focuses and regard different core SPM activities and the goal with several of them was to bring some sort of structure the the field of SPM. However, none of them focuses on the revolutionary change that is currently happening in organizations and fields due to digitalization aspects.

As discussed throughout this thesis, the digital transformation and digitalization of a company bear both advantages and challenges, and there needs to be a major shift in how processes are done and how products are developed to ensure success in the competitive environment. A core function of SPM is to secure investments and the success of a product and it is, therefore, necessary for a new SPM framework that acknowledges the changes of AI and ML to ensure effective implementation of the technologies to secure competitiveness.

The created framework explains how aspects of digitalization, data, AI and ML tools and components, and other advancements within strategies and the role in SPM affect the core process of SPM. The center of the framework shows how AI and ML relate to the continuous process of improvement of products. Implementing the aspects of digitalization and different strategies effectively leads to more informed decisions by utilizing data as a base, being able to make predictions of the market and the customer needs, as well as doing more customer-centric actions that allow for higher rates of customer satisfaction. All of these aspects lead to an increased product value and more profits for the organization. Therefore, this framework is important for the overall success of an organization and to make sure that the or-

ganization stays competitive in the continuously evolving digital landscape.

Another aspect that the created framework acknowledges is the importance of preparation work that needs to be done by the different actors, the individual within SPM, the organization, and the customers. Because AI and ML bring demanding challenges it is important to ensure that the actors are prepared to minimize damage and increase the success rate. By having constructed perspectives that adequately complement the framework and address the difficulties that the integration brings to SPM and the products, the challenges of the implementation will decrease.

During especially the interviews, the insights that organizations have diverse approaches to applying the responsibilities and activities of SPM internally came to light. The field of SPM is large and because of this, it is common to split the responsibilities into several roles instead of having one person taking care of all aspects. This in combination with organizations working differently because of factors such as size, amount of resources, the product they are developing, the maturity level of the organization, and so forth, leads to the need for a generalized framework that suits a wider range of companies. The framework created in this thesis is more general because of this.

In relation to the paragraph above, one additional aspect of the generalizability of the framework is the matter of digitalization which constantly transforms the market and products. In combination with customers and users increasing the need for constantly improving the products, there is a need to continuously change the way of working to keep up with the changing demands and technologies. Also mentioned in the workshop was that there is a high cost and commitment related to changing the ways of working within organizations. Because the environment is continuously developing due to digitalization, the organization might only be able to commit to a certain way for a sprint or a release before new ways are created. Therefore, a framework that generalizes what is required from an individual within SPM and an organization was created to ensure that it would be relevant for a longer period.

Another reason for keeping the framework relatively high-level was that the investigation from the SLR and the interviews did not result in any insights on core activities that AI and ML could fully replace. It was concluded that all responsibilities within SPM needed some form of human involvement. This could be important decisions or an activity that needs communication with other people. This does not mean that this will always be the case. From the interviews, it was clear that many of the companies are at the beginning of their journey to start utilizing the advantages of AI and ML, and because of digitalization, the continuously evolving environment will keep transforming, which will lead to new requirements and ways of doing SPM. Therefore, a low-level framework with a strong connection to how things are currently being done would have become irrelevant faster than the developed high-level framework which will be used as a guide during the upcoming challenges and shifts.

6.2 Key contributions

This research fills in the gap of how the field of SPM can utilize AI and ML components within the products for which they are responsible as well as AI and ML tools to be more efficient. The thesis addresses the challenges that arise when individuals and companies implement strategies and procedures that allow for effective utilization of the advantages of the technologies within products and smooth integration of the tools. It also bridges the gap in understanding how SPM currently uses AI and ML within products to make the most out of their benefits as well as understanding how SPM are and can leverage AI and ML tools to their advantage.

There has not been much research on how to apply AI and ML within the field of SPM but this research, much like previous ones mentioned in the related work in section 2.4, presented findings related to improved decision-making and more customer satisfaction. Utilizing AI and ML within various activities in SPM has been researched before and presented results similar to the findings in this thesis. AI and ML can help in diverse activities but mainly assist in parts such as assisting in finding trends and patterns in data and automating various tasks. The earlier research also provides information about challenges such as integrating AI within existing systems, the complexities of data, and ethical concerns. These challenges were also found during the conduction of this thesis.

The research conducted in this thesis confirms much of the research that has been presented before. Previous research has discussed possible use cases for integrating AI and ML within the field of SPM but what this thesis has brought to the attention is that several aspects need to be considered and investigated before this is possible.

With digitalization and the involvement of AI and ML, tough challenges and problems arise for individuals within the field, organizations, and customers to go through this journey smoothly. There has not been any research that provides information and requirements for the integration of AI and ML within processes and products for the various actors that affect SPM. Therefore, this research provides detailed guidelines on how individuals, organizations, and customers should prepare for the implementation of AI and ML to decrease the disruptive effects. The research that has been conducted previously has a more theoretical approach. So, conducting research that also involves information from industrial practitioners of SPM, which this thesis has, leads to gathering more thorough knowledge about the field of AI and ML within SPM.

An SPM framework was empirically derived from the accumulated information. The framework adequately addresses the various challenges and uncertainties that digitalization and its diverse aspects bring to the field of SPM and displays how this can create more product value by doing more customer-centric actions, becoming more productive, and making more data-driven decisions. It provides guidelines on how to effectively acknowledge the effects and changes that AI and ML components and tools bring to the field. This is done by showing how AI and ML integrate into

SPM as well as preparing individuals, organizations, and customers for the shift to involve more of the technologies.

The created SPM framework is different compared to previously constructed frameworks. None of the frameworks that are presented in section 2.3.1 acknowledges the disruptive challenges that the integration of AI and ML brings and how to mitigate these challenges. These frameworks try to enforce a structure to the field of SPM and therefore focus more on the core activities. The ones presented in the related work, in section 2.4 focus on the different approaches to incorporating AI and ML into SPM and how AI and ML can be integrated into business practices. The framework presented in this thesis gives an overview of different areas of AI and ML application in SPM and the changes that must be made. It does not solely focus on the business aspects but more on how it can create product value for all actors within SPM. None of the frameworks have additional perspectives to help guide the transformation to make it as smooth as possible.

6.3 Limitations

A primary limitation of this research was the time limit. Because the study had to be conducted and finished during a specific period some constraints had to be applied such as the amount of interviewees and the amount of iterations done to construct the framework. Although the concentrated sample may not encompass the entire range of challenges and information present in the broader industry, it provides a detailed and nuanced understanding of AI and ML within SPM. This offers valuable, in-depth perspectives that enrich the understanding of AI and ML used in SPM. While acknowledging that these findings may not cover every possible scenario in the field, they nevertheless contribute to the overall knowledge and provide a foundation for more extensive research.

The created framework was also affected by the limited time of the study. To ensure the validity of the created framework a workshop and interviews were conducted. However, after re-iterating the framework there was no time to re-do validation to ensure the complete validity of the new framework. This limitation highlights the possibility for future research to revisit and strengthen the SPM framework through additional validation by possibly involving a wider range of stakeholders and companies. Despite these insights, the initial validation process provided valuable understandings and ground for further development and refinement in additional iterations.

An additional limit of this study was the access to different databases during the SLR. During the conduction of the SLR and when searching through the databases Google Scholar and Scopus, they were redirected to other databases that were outside of the free or the Chalmers access. Therefore, these articles could not be investigated. Regardless of this, a comprehensive set of literature could be gathered to ensure rich and in-depth answers to the SLR questions.

6.4 Threats to validity

The external validity of the research could be threatened since the study contains a limited set of companies and interviewees and workshop participants from these companies. This could affect the generalizability of the research because all companies are different in regards to size, what product they are developing, as well as the structure of the company. However, the companies that the interviewees came from ranged from a few hundred in size to 100.000 employees and they were active within various areas such as energy and automotive. The interviewees also worked with diverse aspects in the field of SPM and they all had experience ranging from a few years to over ten years within SPM. Therefore, the presented results of the research questions and the created SPM framework are relevant for various types of organizations working with software products, have individuals who work within SPM, and aim to integrate AI and ML into products and processes.

On this note, the interviewees could also affect the external validity considering that their roles and responsibilities varied. As has been discussed throughout this thesis, the field of SPM is wide and the responsibilities are divided differently between companies. The people interviewed and the participants in the workshop in this study could bring their own biases, which can influence the data collected. These biases might manifest in several ways, such as overemphasizing the successes or underplaying the challenges of AI and ML within products and using AI and ML tools in SPM due to personal or corporate interests. They might also have preconceived notions about what constitutes the 'effective' use of AI and ML tools, which could color their responses.

The internal validity of the study is affected by the thesis authors. The study's authors come from different backgrounds and may have different opinions about the role of AI and ML in SPM and their expectations about the study's outcomes. This can shape various aspects of the research process. From formulating the SLR protocol and interview questions to interpreting data, there is a risk of introducing subjective biases. Such biases might inadvertently influence the way the interviews are conducted, responses are interpreted, and findings are presented, potentially leading to a skewed representation of the actual scenario.

6.5 Future research

The research conducted in this thesis will lay a base for upcoming research within the field of SPM and the utilization of the advantages of AI and ML within products as well as AI and ML tools within the field. The SPM framework created provides general guidelines for people within SPM to address the challenges that digital transformation and digitalization, AI, and ML bring. There is a need to continuously update the framework because of the ever-evolving landscape of SPM, technologies, and the industry in general. The research done in this thesis has captured the current landscape of SPM and AI and ML within the field and developed a framework

that accurately acknowledges these findings. However, they are currently developing fields that require a continuous updating of the framework to ensure that it properly mirrors the present challenges and developments that have happened.

Further work can be done to create application models based on the framework presented in this work for the sake of having more concrete actions that can be based on more specific challenges that diverse individuals and organizations face. As has been mentioned, both the roles of the individuals and the organizations vary on several different aspects and therefore it could be an advantage to generate application models that focus on distinct aspects of them.

Currently, there are no entry points within the framework for new organizations that are starting their journey towards utilizing the power of AI and ML within SPM. There is a need to address this gap to acknowledge the challenges that emerging businesses and teams are facing and to ensure that they have a foundation that they can utilize to take advantage of the power of AI and ML. Because of the rapid advancements that digital transformation and digitalization bring, it can be difficult to keep up with the companies that have resources and their strategies set.

7
Conclusion

This master's thesis explored the impact and opportunities of AI and ML within the realm of SPM by conducting an SLR and interviews with industrial practitioners of SPM. This allowed the researchers to adequately understand the challenges that implementing AI and ML within products and processes brings to the field. This research also contributes to the understanding of how SPM takes advantage of AI and ML within the products as well as how the field is leveraging AI and ML tools today and potential use cases for the future.

The findings of the thesis were that integrating AI and ML into SPM is important for enhancing decision-making processes, optimizing the product lifecycle, and introducing a higher level of automation and predictive capabilities than before. These technologies facilitate a more data-driven approach to SPM, enabling SPM professionals to predict market trends, customer needs, and product evolution with much-improved accuracy. However, the integration of AI and ML does not come without its challenges. Issues such as data quality, ethical concerns around AI decision-making, and the need for significant cultural changes within the organization were identified as major hurdles. Furthermore, the thesis highlights a gap in existing SPM frameworks, which fails to include how to integrate and leverage AI and ML capabilities.

By utilizing the information gained from answering the thesis' research questions, an empirically derived SPM framework was able to be created. The constructed framework addresses the changes that AI and ML bring to the field of SPM as well as provides guidelines for helping individuals and organizations in the journey of digitalization. It acknowledges the implementation challenges and presents complementary perspectives that assist individuals, organizations, and customers in preparing for the integration. Finally, it also adds to SPM by assisting in understanding where AI and ML can be applied to maximize the technologies' advantages and create more product value.

The framework provides general guidelines for SPM practitioners and highlights the need for continuous updates due to the evolving nature of technologies and industry landscapes. Additionally, the thesis identifies the possibility of creating application models tailored to specific challenges faced by diverse individuals and organizations and emphasizes the importance of including entry points for new organizations starting to leverage AI and ML within SPM.

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A

Appendix 1

A.1 Systematic Literature Review Protocol

Why is the systematic review conducted? Identification and scope of the review
There is a research gap in understanding the full scope of utilizing AI and ML components and tools in Software Product Management (SPM). A comprehensive review is necessary to identify current research on their effects and applications within SPM, assess their benefits and limitations, and explore their impact on various aspects of SPM. Additionally, it's imperative to investigate how AI and ML contribute to enhancing decision-making processes, optimizing resource allocation, and fostering innovation in SPM. Furthermore, understanding the potential challenges and ethical considerations associated with the integration of AI and ML in SPM is crucial for ensuring responsible and effective implementation strategies.

Questions to specify the problem area

- **SLR-Q1:** How are Artificial Intelligence (AI) and Machine Learning (ML) currently being utilized to drive digitalization within companies?
  - SLR-Q1.1: What are the various applications and use cases with AI and ML?
  - SLR-Q1.2: What are the challenges when applying/using AI and ML in software companies?
- **SLR-Q2:** What are the primary responsibilities and functions in the role within software product management?
  - SLR-Q2.1: What are the major challenges faced in SPM, and how are they typically addressed?
  - SLR-Q2.2: What methodologies must software product management adapt their work to?

Time frame

- 16/1 - 17/3

Inclusion and exclusion criteria

- Inclusion: relevant to at least "1" main question and if applicable, at least "1" sub-question
- Exclusion: not in English
- Exclusion: policy literature, working papers, newsletters, government documents, speeches, non-published journals, or articles

- Exclusion: articles with business/marketing/banking, health care/medicine, education, insurance, or agriculture in the title
- Exclusion: abstracts

Quality critera
Level of agreement:
- No (0)
- Partially (0.5)
- Yes (1)

Quality assessment checklist for quantitative studies:
- Are the aims clearly stated?
- Was the sample size justified and representative of the population to which the results will generalize?
- Are the variables used in the study adequately measured (i.e. are the variables likely to be valid and reliable)?
- Was the outcome assessment blind to the treatment group?
- Are the data collection methods adequately described?
- Is the purpose of the analysis clear?
- Are potential confounders adequately controlled for in the analysis?
- Does the study address the potential of Selection bias?
- Does the study address its questions, including negative and null findings?
- Does the study have implications for practice?
- Do the researchers explain the consequences of any problems with the validity/reliability of their measures?

Quality assessment checklist for qualitative studies:
- Are the findings credible?
- Does the evaluation address its original aims and purpose?
- Is the scope for drawing wider inference well explained?
- Are the sample design/target selection of cases/documents well defined?
- Was the data collection appropriately carried out?
- Are the links between data, interpretation, and conclusions clear?
- Has the research process been adequately documented?

Data sources
- ACM
- Google Scholar
- IEEEXplore
- Science Direct
- Scopus

Search terms
Keywords:
- digitalization or digitalize
- AI or Artificial Intelligence

- ML or Machine Learning
- software product management
- methodologies
- challenges

Canonical search equations

- **SLR-Q1**
  - SE1: (digitalization OR digitalize OR digitalisation OR digitalise OR digital transformation) AND ((AI OR Artificial Intelligence) OR (ML OR Machine Learning))
  - SE2: (digitalization OR digitalize OR digitalisation OR digitalise OR digital transformation) AND ((AI OR Artificial Intelligence) OR (ML OR Machine Learning)) AND (challenges, difficulties, problems, issues, obstacles)
- **SLR-Q2**
  - SE3: (software product management OR software product manager OR software product managers OR SPM) AND (role OR roles OR responsibilities OR tasks OR requirements OR activities)
  - SE4: (software product management OR software product manager OR software product managers) AND (methodologies OR method OR methodology OR agile)
  - SE5: (software product management OR software product manager OR software product managers) AND (challenges, difficulties, problems, issues, obstacles)

A.2 Data Collection Form

Name of the reviewer:
Date of data extraction:

Research information
Title:
Authors:
Journal (if applicable):
Publication details:
Name of database retrieved from:

Basic information
What kind of study?
Number of companies researched:
Number of countries represented:
Description of the perspective of the study

Questions
AI/ML
How can AI and ML be used to drive digitalization forward within companies?
How can it be used in a broader aspect, between companies or between different sectors?
What are the challenges when applying/using AI and ML in companies?
How are these challenges typically addressed?

SPM
What are the primary responsibilities and functions in the role within SPM?
What are the major challenges faced in SPM?
How are these challenges typically addressed?
What methodologies/frameworks do SPM adapt their work to?

A.3 Interview Guide

PHASE 1 Introduction

- *Start the interview*

First of all, thank you so much for participating in this interview! We appreciate it very much and this information is invaluable for our master's thesis work!

- *Ask if it's okay to record the interviewee for transcription and analysis*
- *Describe objectives of the interview and the master thesis*

This master's thesis aims to pinpoint the obstacles encountered by software product management in integrating AI and machine learning components into products and tools into the responsibilities of the role. Utilizing this insight, the objective is to develop either a novel framework or enhance an existing one, enabling the maximization of these technologies' benefits. Therefore, conducting interviews serves the purpose of collecting insights from professionals working within the domain.

- *If a partner with Software Center, mention the NDA*
- *Mention that when we are talking about AI we include machine learning and all other tools under that umbrella term*

PHASE 2 Introductory questions

- What is your name?
- How old are you?
- What is your background? For example, education or previous work experience
- Which company do you work for?
  - Roughly how many works at your company?
- What is your role/job title?
  - Can you summarize your primary responsibilities?
- For how long have you worked at the company in the specific role?
- Have you worked at another company with the same role or responsibilities?
  - If yes, for how long?
- Can you describe your company's workflow and processes?
  - What frameworks, structures, or/and techniques do you use?
    - How do you use those frameworks?

      If not answered in the questions above
    - Do you use any agile techniques?
      - What do your sprints look like?
      - What agile roles do you have?

- What do your feedback loops look like? This could be for example from the customer of the product

  - How do you and your company make use of these feedback loops?
  - How often do you review data from the feedback loops?
- Does your company use strategic data collection?
  - How does your company take advantage of the data you collect in decision-making?

PHASE 3 Main questions

During this phase, we will ask you about your workflow in software product management. Our investigation centers on how you leverage AI within your work processes. If you presently do not utilize any tools of this nature, your insights on how you could potentially integrate them would be highly valuable to us.

Individual

- How do you utilize AI as a tool for your work-related tasks?
  - What kind of AI tools do you incorporate?
  - Are there any parts of your work that would not be able to be utilized by these tools?
- What were the successes and challenges with implementing AI as a tool for you in your role?
- What are the positive and negative effects of having AI as a tool in the workplace?

  If the interviewee currently uses AI tools in their work
  - In your experience, how does using AI tools in your role differ from when you were not able to use them?
  - What were the challenges before and after implementing AI tools regarding tasks within software product management?

Team

- How has the team/teams that you are working with incorporated AI into their work-related tasks?
  - What is their general opinion on using AI in the workplace?

    If the team/teams are using AI tools
  - What were the successes and challenges that they had when implementing them?

Company

- How does the company that you are currently working at view incorporating AI as a tool in diverse tasks?
- Has there been any information on policies or regulations for using AI?
- Have you had any training, for example, an introduction/workshop/course, for how to handle AI at your workplace?

Other

- What is your personal opinion about AI within software product management?
- What future outlooks do you think AI will have in the field of software product management role and the industry?
- Have the company, team or you discussed or thought about the ethical aspect of AI?

PHASE 4 Ending questions

- Is there anything additional you'd like to share or any topic we haven't covered yet that you'd like to discuss?
- Do you have any questions for us?

PHASE 5 Finishing the interview

- *Thank the interviewee for their time*

A.4 Initial Thematic Map

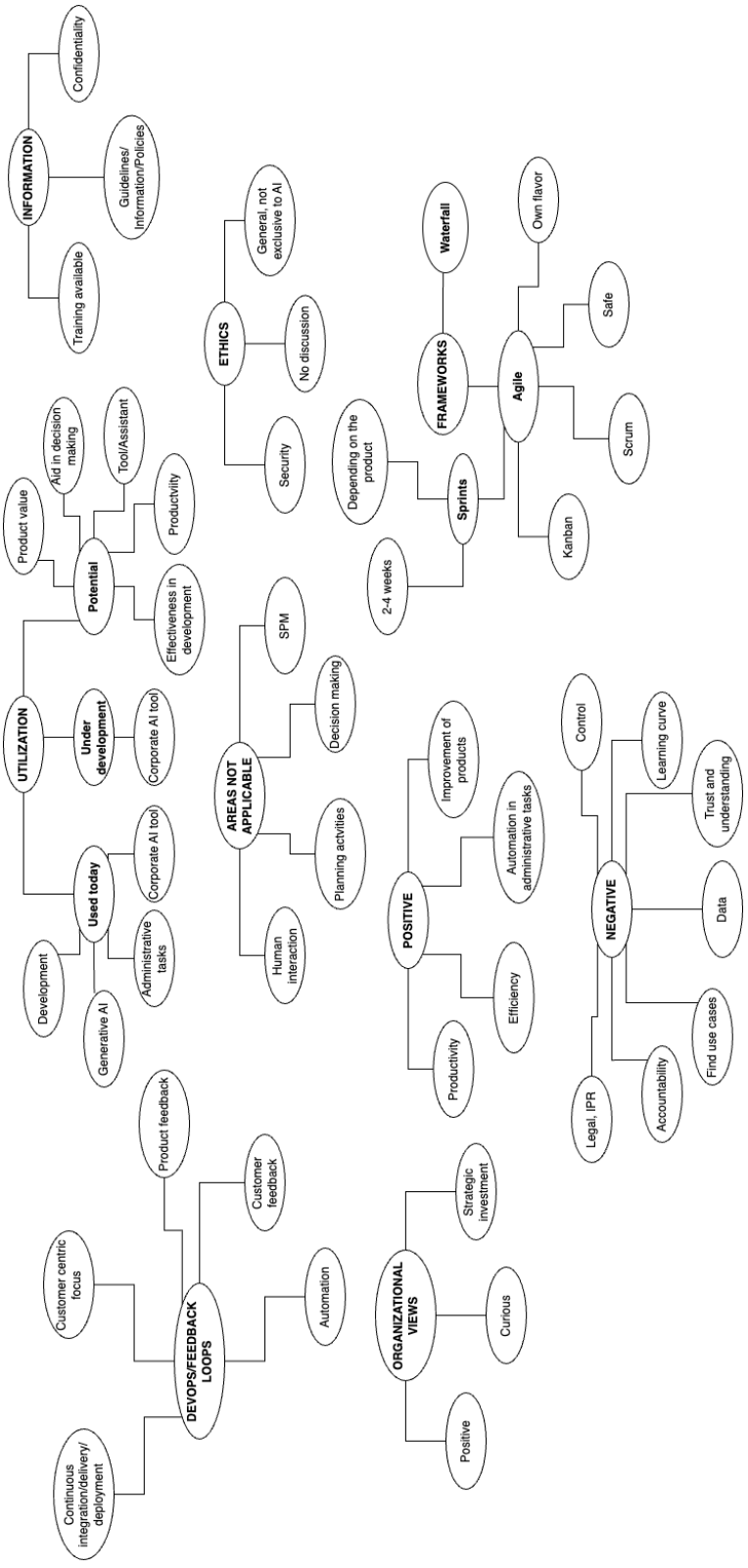

Figure A.1: The initial thematic map over the themes from the interviews

A.5 Second Thematic Map

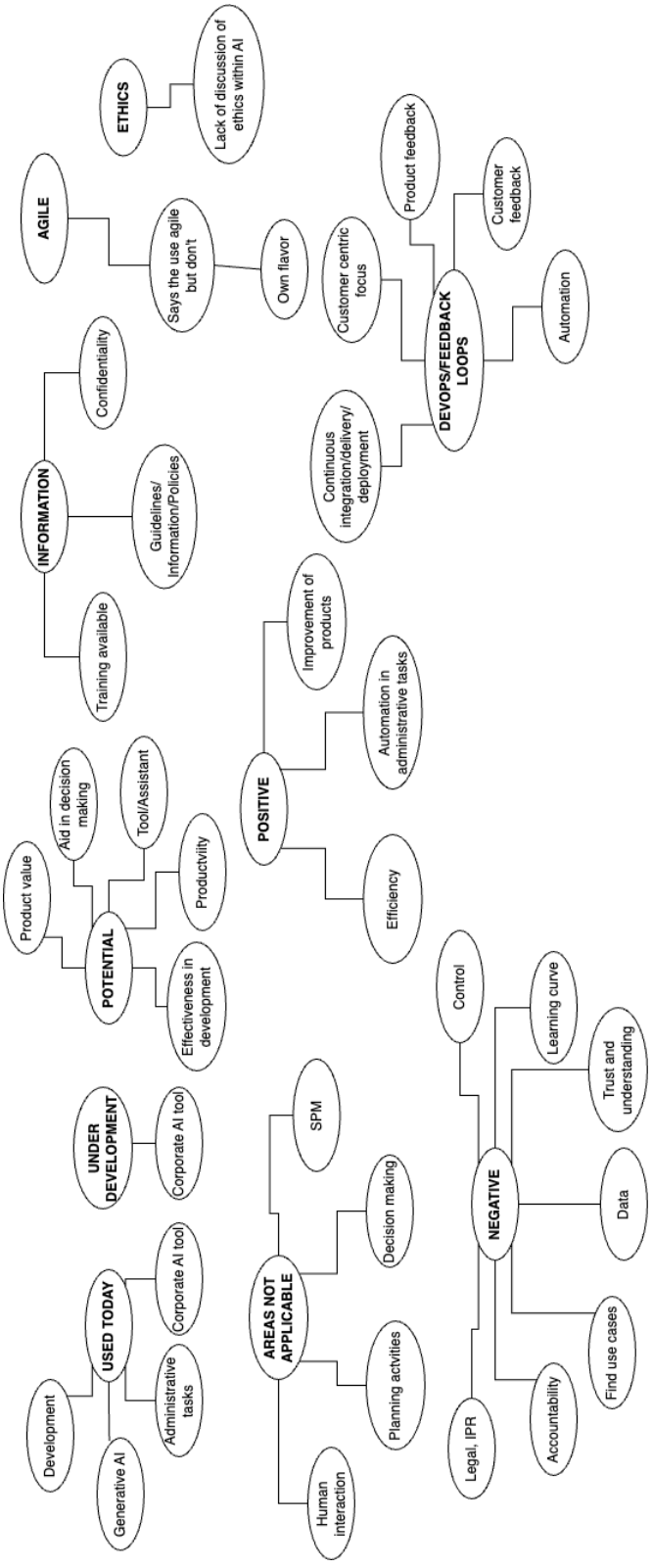

Figure A.2: The second thematic map over the themes from the interviews

A.6 Validation Workshop Guide

PHASE 1 Introduction

- *Introduction of the participants*

All participants were asked to introduce themselves with their name, what their current occupation is, as well as why they had chosen to participate in the workshop.

- *Explanation of the framework*
  - *Framework derivation*
  - *Goal with the framework*
  - *Framework - Digitalization*
  - *Framework - Advancements*
  - *Framework - Software Product Management*
  - *Framework - Product Value*

- *Perspectives*
  - *Organization*
  - *Individual*
  - *Customer*

PHASE 2 Main part

- *Miro board*

During the workshop, a Miro board was used as a tool and therefore this was introduced and explained before starting.

- *5 minutes of reflection*

The participants were asked to take five minutes to reflect on the framework by themselves with the help of the following questions:

1. *What is your first impression of the framework?*
   (a) *Is it clear and understandable?*
2. *What parts need adjusting?*
3. *Are there any parts missing?*
4. *Are there any parts that need to be removed?*

- *Group discussion*

The group discussions were done in smaller groups in breakout rooms with the same questions as presented in the previous part.

- *Construct solutions*

The goal was to explore the ideas on how to improve the framework and was based on the factors presented here:

1. *Parts that need adjusting and why*
2. *New parts to add and why they should be added*
3. *Parts to remove and why they should be removed*

- *Full group discussion*

The full group discussions were done to inform each group what they had talked about and also to see if they had any additional insight that could help improve the framework.

1. *What were the main discussion points in each of the groups?*
2. *Are there any additional insights?*

PHASE 3 Summarizing and conclusions

- *Final reflections*

The goal of the final reflections is to summarize all of the reflections and to see the potential challenges and usage of the framework. It is also to round up the discussions.

1. *What are the potential challenges with this framework?*
2. *Will you use/take inspiration from the framework when adding AI and ML in SPM?*
3. *What are the main takeaways from this workshop?*

- *Thank the participants for their time*

A.7 Validation Interview Guide

PHASE 1 Introduction and purpose

- *Start the interview*

First of all, thank you so much for participating in this interview! We appreciate it very much and this information is invaluable for our master's thesis work!

- *Describe objectives of the interview and the master thesis*

This master's thesis aims to pinpoint the obstacles encountered by software product management in integrating AI and machine learning components into products and tools into the responsibilities of the role. Utilizing this insight, the objective is to develop either a novel framework or enhance an existing one, enabling the maximization of these technologies' benefits. The goal with this interview is to gather feedback about the created software product management framework to validate it.

PHASE 2 Present the framework

- *Explanation of the framework*
  - *Framework derivation*
  - *Goal with the framework*
  - *Framework - Digitalization*
  - *Framework - Advancements*
  - *Framework - Software Product Management*
  - *Framework - Product Value*

- *Perspectives*
  - *Organization*
  - *Individual*
  - *Customer*

PHASE 3 Main questions

5 minutes of reflection

1. What is your first impression of the framework?
   (a) Is it clear and understandable?
2. What parts need adjusting?
3. Are there any parts missing?
4. Are there any parts that need to be removed?
5. What advantages do you see?

Cosntruct solutions

1. Parts that need adjusting and why
2. New parts to add and why they should be added
3. Parts to remove and why they should be removed

Final reflections

1. What are the potential challenges with this framework?
2. Will you use/take inspiration from the framework when adding AI and ML in SPM?
3. What are the main takeaways from this interview?

PHASE 4 Ending questions

1. Is there anything additional you'd like to share or any topic we haven't covered yet that you'd like to discuss?
2. Do you have any questions for us?

PHASE 5 Finishing the interview

- *Thank the interviewee for their time*